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The Engineer

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PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere road, Lambeth, S.E. 1, invites TENDERS for :—
1. STONE-BREAKING PLANT, SCREENS, HOPPERS and OIL ENGINES.
2. COMBINED STEAM GRAB and DRAG-LINE EXCAVATORS, 28ft. Boom and 8 c. ft. Bucket.
Tenders due on the 1st April, 1926, for No. 1, and on the 13th April, 1926, for No. 2.
Tenders form obtainable from the above. 1900

Assistant Engineer Re- QUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officer appointed will be eligible at the expiration of three years' service in the post for confirmation in the permanent and pensionable establishment. Salary £480 a year for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, unmarried, must have passed the examination for A.M.I.C.E. or possess a degree in Engineering recognised by the Institution as exempting from Parts A and B of the Examination. They must have had proper technical training and preferably have had not less than two years' subsequent experience on large Engineering or Municipal Works. Candidates possessing other engineering qualifications may apply.—Applications should be made at once by letter, stating age, qualifications and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting reference M/14,375. 1918

Assistant Engineers (4) DRAUGHTSMEN (2) REQUIRED for the NIGERIAN RAILWAY CONSTRUCTION, for a tour of 12 to 18 months' extension. Free passages and a commuted bush and travelling allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary.
M/14,155 : ASSISTANT ENGINEERS (4).—Salary £480 for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Candidates, aged 25 to 40, must be fully trained Engineers with experience on Railway Location.
M/14,156 : DRAUGHTSMEN (2).—Salary £480 for the first three years of service, then £510, rising to £720 a year by annual increments of £30. Candidates, aged 25 to 40, must be fully trained Engineers with experience on Railway Survey Work and Plotting from Field Books.
Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, clearly quoting the reference number of the vacancy applied for. 1907

Assistant Engineers Re- QUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably as a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diplomas or distinction in engineering as the Secretary of State may decide in any particular case, or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer. Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at head of application M/14,376. 1895

Safety in Mines Re- SEARCH BOARD.
APPOINTMENT.
The Safety in Mines Research Board REQUIRES an INVESTIGATOR to carry out work on the Strengths of various Materials and Structures for the Support of Underground Workings in Coal Mines.
Applicants must possess a University Degree or its equivalent in Engineering, have a good knowledge of testing materials and be good draughtsmen. Preference will be given to ex-Service men.
The appointment is tenable in London and will be subject to the provisions of the Federated Superannuation Scheme for Universities. The salary will be £250 a year inclusive.
Forms of application, which must be returned not later than 6th April, can be obtained from the UNDER-SECRETARY for MINES, Establishment Branch, Mines Department, Dean Stanley-street, Millbank, S.W. 1. 1864

Basingstoke Corporation Elec- TRICITY DEPARTMENT.
TENDERS are INVITED for the SUPPLY, DELIVERY and ERECTION of :—
ONE 600 B.H.P. VERTICAL CYLINDER HEAVY OIL ENGINE and DIRECT-COUPLED DYNAMO
OIL ENGINE and DIRECT-COUPLED DYNAMO.
Specification, general conditions and form of Tender may be obtained from Mr. F. Swarbrick, Borough Electrical Engineer, Electricity Works, Basingstoke, on a deposit of £2, which amount will be refunded on receipt of a bona fide Tender.
Duplicate copies of specification, &c., may be had on payment of 10s. per copy, not returnable.
Sealed Tenders, marked "Tender for Generating Plant," to be delivered to the undersigned not later than Noon on 6th April, 1926.
R. H. WANKLYN, Town Clerk.
Municipal Offices, Basingstoke,
March 12th, 1926. 1874

TENDER.
City of Stoke-on-Trent.
GAS CONSOLIDATION ACT, 1922.
CONTRACT NO. 55.
The Gas Committee invite TENDERS for the whole of the SECTIONS of this CONTRACT, or for ONE or MORE SECTIONS separately.
SECTION 1.—STORES BINS and SHELVING.
SECTION 2.—OIL STORAGE TANKS and EQUIPMENT.
SECTION 3.—LABORATORY FURNISHING and EQUIPMENT.
SECTION 4.—ELECTRICAL and other MACHINERY.
SECTION 5.—GAS ENGINE and DYNAMO.
SECTION 6.—PARTITIONING for OFFICE.
SECTION 7.—STEAM LOCOMOTIVE.
Persons desirous of tendering are requested to make written application to the Chief Gas Engineer, Gasworks, Etruria, Stoke-on-Trent, not later than Saturday, 3rd April, and to enclose a deposit of £1 Treasury Note, which will be returned on receipt of a bona fide Tender and the return of all plans and documents, and also provided Tenders are received by the date mentioned.
Sealed Tenders to be forwarded to the undersigned not later than Twelve Noon on Monday, 12th April, and endorsed "Contract No. 55, Gas Department."
E. B. SHARPLEY, Town Clerk.
Town Hall, Stoke-on-Trent.
March 16th, 1926. 1877

Felixstowe Urban District COUNCIL.
The Urban District Council is desirous of receiving TENDERS from contractors for the CONSTRUCTION of a SEA OUTFALL SEWER, 12in. diameter and 730 yards long.
Specification and bills of quantities may be obtained on application to the undersigned on payment of Three Guineas, which will be returned on receipt of a bona fide Tender.
Fully priced Tenders in a sealed and endorsed envelope should be delivered to the undersigned not later than first post Monday, the 29th instant. The lowest or any Tender will not necessarily be accepted by the Council.
H. CLEGG, A.M.I.C.E., Engineer and Surveyor.
Surveyor's Office,
Town Hall, Felixstowe. P1707

PUBLIC NOTICES

The Institution of Chemical ENGINEERS.
EXAMINATIONS for the ASSOCIATE MEMBERSHIP of the INSTITUTION WILL BE HELD in JUNE and JULY NEXT.
Particulars of the examinations and the Memorandum on "The Training of a Chemical Engineer," may be obtained on application to the Hon. Registrar, C. S. GARLAND, Esq., the Institution of Chemical Engineers, Abbey House, Westminster, London, S.W. 1 1919

Royal State Railways of Siam.
Sealed TENDERS for the SUPPLY of STEAM or INTERNAL COMBUSTION SHUNTING LOCOMOTIVES will be received by the undersigned at his office in Bangkok (Siam) up to 3 p.m. on Monday, the 28th June, 1926, at which place and hour the Tenders will be publicly opened and read.
Blank Tender forms, specifications and plans may be obtained from Messrs. C. P. Sandberg, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £1 10s. per set, which sum will not be refunded.
Right is reserved to reject any or all Tenders and to accept any Tender which in the opinion of the undersigned is to the best interests of the Royal State Railways.
Royal State Railways of Siam,
PURACHATRA,
1863 Commissioner-General.

Slough Urban District Council.
PUMPING PLANT.
The Council invite OFFERS for the INSTALLATION of PUMPING PLANT to lift 50,000 gallons of water per hour from a 30in. dia. borehole at Datchet.
Contractors may Tender for either Oil Engine or Motor-driven Pump, which is to draw water about 60ft. below surface.
Particulars can be obtained from, and Offers, endorsed "Pumping Plant," should be delivered to the undersigned by Noon on Monday, the 19th April, 1926.
ALAN BROMLY, A.M.I.C.E.,
Water Engineer,
William-street, Slough.
Slough, 15th March, 1926. 1862

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—
4105 TONS 90 lb. F.F. RAILS.
2365 TONS 90 lb. B.H. RAILS.
9014 TONS 60 lb. F.F. RAILS.
Together with FISH-PLATES.
The steel must be made by one of the following processes :—
Acid Open Hearth,
Basic Open Hearth,
Acid Bessemer.
Delivery, three equal consignments each type, May, June, July, 1926.
For each copy of the specification a fee of One Guinea will be charged and is not returnable.
Tenders, enclosed in sealed envelopes and endorsed "Tender for Rails," must be delivered at the Company's offices not later than Twelve Noon on Friday, the 26th March, 1926.
The Directors do not bind themselves to accept any or the lowest Tender and reserve the right to divide the order.
12th March, 1926. [1861 ¶

PUBLIC NOTICES

The County of London Elec- TRIC SUPPLY CO., LTD.
BARKING POWER STATION EXTENSIONS, 1926.
TENDERS INVITED.
The County of London Electric Supply Company, Ltd., are open to receive TENDERS for the SUPPLY and ERECTION of the following APPARATUS at their Barking Power Station :—
(1) Circulating Water Pumps and Pump-house Equipment.
(2) Circulating Water Screening Plant.
(3) Boiler-house Coal-handling Plant.
Specifications may be obtained by manufacturers from the offices of the Company on application to the undersigned on or after March 23rd, 1926, on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy.
Separate sealed Tenders, marked "Tenders for Circulating Water Pumps and Pump-house Equipment" or for "Circulating Water Screening Plant" or "Coal-handling Plant," should be addressed to the undersigned and lodged at the registered office of the Company by Noon on the 20th April.
Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.
The Company do not bind themselves to accept the lowest or any Tender.
F. C. McQUOWN,
Joint Manager and Secretary,
County of London Electric Supply Co., Ltd.
Moorgate-court,
Moorgate-place, London, E.C. 2. 1896

Tyne Improvement Commission.
The Tyne Improvement Commissioners are prepared to receive TENDERS :—
For the CONSTRUCTION, DELIVERY and ERECTION at their Engineering Yard, Howdon-on-Tyne, of
(1) ONE 5-TON OVERHEAD ELECTRIC TRAVELLING CRANE.
(2) ONE 24in. DIAMETER HIGH-SPEED COMBINED SURFACING BORING, MILLING, DRILLING and TAPPING MACHINE.
And for the CONSTRUCTION, DELIVERY and TESTING at their South Pier Works, South Shields, of
(3) ONE WHOLE-TIME ROCK GRAB.
Copies of the forms of Tender, conditions of contract and specification may be obtained on application at these offices.
Tenders must be sent to the undersigned under cover, endorsed "Tender for Electric Crane," "Boring Machine," or "Rock Grab," as the case may be, not later than Noon on the 31st day of March, 1926.
The Commissioners do not bind themselves to accept the lowest or any Tender.
By Order,
ALBERT BLACKLOCK, Secretary.
Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
17th March, 1926. 1883

Walthamstow Urban District COUNCIL.
ELECTRICITY DEPARTMENT.
The above Council invite TENDERS for the SUPPLY, DELIVERY and ERECTION at the Electricity Works, Exeter-road, Walthamstow, of the undermentioned PLANT :—
CONTRACT No. 61.—Steel Overhead Bunkers and Boiler-house Buildings.
CONTRACT No. 62.—Coal and Ash Conveying Plant.
Copies of the general conditions, specifications, drawings, and forms of Tender can be obtained from Mr. G. R. Spurr, Electricity Works, Exeter-road, Walthamstow, E. 17, on depositing the sum of £1 (One Pound) in respect of each contract, which amount will be refunded on receipt of a bona fide Tender, and to the successful tenderer on completion of the contract.
Additional copies of the specifications may be had on payment of 5s. (Five Shillings) per copy, which amount will not be refunded.
Sealed Tenders, on the prescribed forms, endorsed "Tender for Bunkers and Buildings" or "Conveying Plant," to be delivered by post only to the undersigned not later than Twelve o'clock Noon on Tuesday, 13th April, 1926.
The Council do not bind themselves to accept the lowest or any Tender.
The contractors will be required to observe the Fair Wages Clause applicable to Government Contracts.
C. SYDNEY WATSON,
Clerk to the Council.
Town Hall, Walthamstow, E. 17.
8th March, 1926. 1893

Liverpool Corporation Water- WORKS.
TEMPORARY DRAUGHTSMEN REQUIRED.
APPLICATIONS are INVITED for the following TEMPORARY POSITIONS :—
1. SENIOR DRAUGHTSMAN. Salary at rate of £350 per annum.
2. DRAUGHTSMAN. Salary at rate of £270 per annum.
3. JUNIOR DRAUGHTSMAN. Salary according to age scale ; maximum £200 at 27.
Applicants for positions 1 and 2 must have had good experience in design of Waterworks (Gravitation).
Applications, which must be accompanied by full particulars of experience and qualifications and copies of three recent testimonials, to be addressed to the WATER ENGINEER, 55, Dale-street, Liverpool, to be received not later than Wednesday, the 31st March, 1926. 1847

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PUBLIC NOTICES

Administrative County of LONDON.

HOUSING DEVELOPMENT SCHEMES.
APPOINTMENT OF A TEMPORARY ASSISTANT TO ADMINISTRATOR.

The London County Council invites APPLICATIONS for the POSITION of an ASSISTANT on the temporary staff of the Administrator of Housing Development Schemes. The candidate appointed will be required to act as an Assistant in the Control and Supervision of large Contracts of Housing Development Schemes and other works entered into by the Council. Candidates should have been trained either as Civil Engineers or Architects, and have had considerable experience in the Conduct of Large Construction Works. Experience as a Resident Engineer or as an Architect with outdoor experience is required, and commercial knowledge gained on the staff of a large contractor would be a qualification.

Preference will be given to candidates who served or attempted to serve with H.M. Forces.

The salary attached to the appointment will depend upon the qualifications possessed by the successful applicant, and will not exceed an inclusive rate of £1200 a year.

Forms on which application must be made can be obtained either personally or by sending a stamped and addressed foolscaps envelope, marked "Assistant to the Administrator," to the Administrator of Housing Development Schemes, The Old County Hall, Spring-gardens, S.W.1. The latest time for receiving applications is 11 a.m. on Monday, 12th April, 1926.

MONTAGU H. COX,
1914 Clerk of the London County Council.

County Borough of Wolverhampton.

WATER DEPARTMENT.
CHIEF ENGINEERING ASSISTANT.

APPLICATIONS are INVITED from Chartered Civil Engineers for the APPOINTMENT of CHIEF ENGINEERING ASSISTANT to the Water Engineer.

Experience in the design and construction of Pumping Works will be an advantage to the applicants.

The salary and bonus will be £400 per annum, advancing by two annual increments of £25 (salary and bonus), subject to satisfactory service, and subject to percentage deductions in accordance with the Local Government and other Officers Superannuation Act, 1922. The selected candidate will be required to pass a satisfactory medical examination.

Applications, stating age, qualifications, experience, and present salary, together with copies of three recent testimonials, must be delivered to the undersigned before 31st March, 1926, envelopes to be endorsed "Chief Engineering Assistant."

Canvassing members of the Council personally or otherwise will disqualify applicants.

F. E. WARBRECK HOWELL,
Town Clerk.
Town Hall, Wolverhampton,
16th March, 1926. 1888

Great Southern Railways.

JUNIOR DRAUGHTSMEN.

The Directors of the Great Southern Railways REQUIRE FOUR JUNIOR CIVIL ENGINEERING DRAUGHTSMEN, three for the Chief Engineer's Office, Broadstone, Dublin, and one for the District Engineer's Office, Cork. Commencing salary £150 per annum.

Applicants should not exceed 25 years of age.

Previous experience not essential in the case of an applicant who has had a training in a School of Civil Engineering.

Applications, which should state age and give full particulars of training and experience, and be accompanied by not more than two copies of recent testimonials, should be posted so as to reach the undersigned not later than 10 a.m. on 1st April next.

C. E. RILEY,
Secretary.
Kingsbridge Station, Dublin,
11th March, 1926. 1860

New Zealand Government Railways.

APPLICATIONS are INVITED for the POSITION of ASSISTANT CHIEF MECHANICAL ENGINEER. Salary £850 per annum rising to £1000. Age limit 45. Applicants must be Associate Members or Members of the Institution of Mechanical Engineers.—Full particulars and forms of application obtainable from the HIGH COMMISSIONER FOR NEW ZEALAND, 415, Strand, London, W.C. 2, by whom completed applications will be received up to and including the 30th April, 1926. 1902

New Zealand Government Railways.

APPLICATIONS are INVITED for the POSITION of CHIEF DRAUGHTSMAN, Locomotive Branch. Salary £715 per annum. Age limit 45. Applicants must be Associate Members of the Institution of Mechanical Engineers or have passed equivalent examination.—Full particulars and forms of application obtainable from the HIGH COMMISSIONER FOR NEW ZEALAND 415, Strand, London, W.C. 2, by whom completed applications will be received up to and including the 15th April, 1926. 1901

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, an ASSISTANT ENGINEER, with Waterworks Experience; must be a good Draughtsman. Commencing salary £200 per annum, rising by annual increments of £20 to £300 per annum.

Applications, stating age, qualifications and previous experience and enclosing copies of three recent testimonials, to be sent to WATERWORKS ENGINEER, Town Hall Chambers, Ashton-under-Lyne, not later than Wednesday, 31st March, 1926. 1920 A

WANTED, Thoroughly Competent and Up-to-date MECHANICAL ENGINEER for Group of Collieries.—Address, stating qualifications, salary expected, and experience, 1909, The Engineer Office 1909 A

ASSISTANT ENGINEERS REQUIRED IMMEDIATELY for Cement Works Construction. Must be first-class Draughtsmen, with experience in Structural Work and Conveying Machinery.—Address, stating age, experience, and salary required, 1878, The Engineer Office. (No original testimonials.) 1878 A

ENGINEER, Capable Man, WANTED, to Take Charge of the Engineering Side of Large Productive and Distributive Operations. Must thoroughly understand Automatic Plants in connection with Bakery and other Departments and have knowledge of processes in Dairy, Fruit Preserving, Boot Repairing, Refrigeration, &c. &c. Heating and Electrical experience essential.

Applicants must give full details of their experience and show competence to control large staff.

Apply in first instance by letter, stating age, experience, and salary required, to the MANAGER, Royal Arsenal Co-operative Society, Limited, 147, Powis-street, Woolwich, endorsed "Engineer." Applications must be received by March 27th. 1905 A

REQUIRED by Firm of Diesel Engine Manufacturers, a well-educated ENGINEER with considerable Marine Experience.—Address, with particulars of past service and salary required, 1916, The Engineer Office. 1916 A

REQUIRED by Old-established Firm in India a capable MACHINE TOOL SALESMAN, age 24-26, unmarried, with practical Machine Shop experience and conversant with Railway Workshop requirements.—Application must state age, full particulars experience and salary required, to "Z. G. 528," c/o Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 1875 A

REQUIRED IMMEDIATELY, TWO or THREE experienced MECHANICS for Erecting and Running Diesel Engine Plant (high-speed). Applicants will be required to carry out Erection and, where necessary, to remain as Charge Engineer of the Plant.—Address, giving full particulars of qualifications, P1721, The Engineer Office. P1721 A

SITUATIONS OPEN (continued)

SITUATION OPEN.—WANTED, to Supervise important contract abroad, SENIOR STRUCTURAL ENGINEER, age 35-40. Fit for service in the Tropics. Candidates must be A.M.I.C.E. or equivalent. Experience of native labour essential.—Address, 1889, The Engineer Office. 1889 A

TRAVELLER (London District), with Connection among Engineers and Manufacturers, to SELL WELDING PLANTS and ACCESSORIES. Traveller should represent one other firm (non-competitive goods), advertisers bearing half salary. Full particulars and remuneration required.—Address, 1922, The Engineer Office. 1922 A

WORKS MANAGER, with Good Engineering training, used to Mass Production and High Precision Work, REQUIRED in South Midlands. Must be able to handle labour successfully. State age, qualifications, and salary expected.—Address, 1915, The Engineer Office. 1915 A

YOUNG Energetic ENGINEER, Well Educated, experienced in Furnace Design and possessing commercial ability. Good prospects for right man.—Address, stating age, qualifications, and salary expected, 1910, The Engineer Office. 1910 A

WANTED, a First-class DRAUGHTSMAN, Capable of designing modern Tin and Gold Recovery Dredgers. State full particulars and salary required.—Address, 1859, The Engineer Office. 1859 A

WANTED, Experienced LOCOMOTIVE DRAUGHTSMEN, including LEADING HAND. North of England.—Address, stating experience, &c., 1860, The Engineer Office. 1860 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 98, St. George's-square, London, S.W. 1. 1189 A

DRAUGHTSMAN REQUIRED for London District, having wide experience in the Design and Detailing of Structural Steelwork, sound technical training essential and knowledge of Reinforced Concrete an advantage. State full experience, age and salary.—Box 2/A, Geo. Kelly and Co., 14, Victoria-street, S.W. 1. P1724 A

DRAUGHTSMAN REQUIRED, with Experience in Pile Driving and Concrete Placing Equipment. State age, experience, and salary required to—Box No. P474, c/o 19-21, Corporation-street, Birmingham. 1866 A

DRAUGHTSMAN WANTED, Knowledge Package Conveyors.—Write, stating experience, age, salary, BAGSHAWE and CO., Ltd., Dunstable. 1712 A

JIG and TOOL DRAUGHTSMAN WANTED for General Engineering Works. Age 25-30. Must possess ability and initiative.—Address, stating full details of experience, age, and salary required, 1911, The Engineer Office. 1911 A

JUNIOR STRUCTURAL DETAILING DRAUGHTSMAN REQUIRED. London Building experience desirable.—Address, 1867, The Engineer Office. 1867 A

MACHINE TOOL DRAUGHTSMAN, with Shop experience, REQUIRED.—Address, stating experience and salary required, 1870, The Engineer Office. 1870 A

STRUCTURAL STEELWORK.—Thoroughly Experienced DRAUGHTSMAN REQUIRED; capable of Designing all classes of Structural Steelwork for Buildings, and carrying through contracts without supervision. Permanent and progressive post to suitable man. State age and salary required.—Address, P1715, The Engineer Office. P1715 A

TOOL DRAUGHTSMAN WANTED, Experienced on Commercial Vehicle Work.—Address, giving age and full experience, 1917, The Engineer Office. 1917 A

WANTED, Experienced First-class FOREMAN to Superintend the Construction and Erection throughout of Experimental Aircraft. One with Ground Engineer's Licence preferred.—Write, giving full details of experience, copies of references, and wages required, to WESTLAND AIRCRAFT WORKS, Yeovil, Somerset. 1865 A

MECHANICS, FITTERS and ENGINEERS, Desiring more congenial and lucrative employment, should write for particulars of my intensive course in draughtsmanship. There is an increasing demand for qualified draughtsmen and you can learn this interesting profession while you are earning. Postal or private tuition by arrangement.—PERCY PITMAN, M.I. Mech. E., 25 Victoria-street, Westminster, S.W.1. 1907 A

MILLWRIGHT WANTED, Knowledge of Refrigeration, Hydraulic, and Electric experience necessary. Only first-class men need apply.—Address, "MILLWRIGHT," Wm. Porteous and Co., Advertising Agents, Glasgow. P1701 A

SITUATIONS WANTED

AMBITIOUS MAN (36) SEEKS POSITION; Office and works experience, general eng., carr., wagon and loco.; would make good assist. to works manager. Low salary until abilities proved. Who'll give me an opening?—Address, P1692, The Engineer Office. P1692 B

ENGINEER, A.M.I. Mech. E., DESIRES Responsible POSITION; experimental jig and production depts., hydraulic, steam and air automatic devices. Good inventive facilities and organiser.—B., 7, Beechcroft-road, Bushey. P1702 B

SITUATIONS WANTED (continued)

ENGINEER (30), 1st C. B.O.T. Cert., at Present employed chief extensive liquid fuel pumping installation, DESIRES permanent SHORE APPOINTMENT as Shift, Supervisor or Maintenance Engineer. Experienced all types boilers, turbines, reciprocating electric central and sub-stations, and workshop machinery.—Address, P1704, The Engineer Office. P1704 B

ENGINEER, Age 35, Tech. College Education, 18 years' shops and D.O. experience with well-known motor and aircraft firms, DESIRES responsible POST.—Address, P1706, The Engineer Office. P1706 B

ENGINEER, Ex-Manager, Ex-Sub. Director, large firms abroad, ship repairs, dry dock, lighter construction, slipway, &c., practical and technical knowledge all branches trade, harbour experience for marine survey, fluent Spanish, knowledge Portuguese and Italian, B.O.T. Certificate, splendid foreign references, understanding commercial life South American Republics, especially Argentine, DESIRES POSITION, home or abroad, as Representative or Assistant Director of Works.—Apply, PERCY J. BARTHOLOMEW, 33, Queen's-road, Portsmouth. P1682 B

ENGINEER, Mechanical and Electrical, SEEKS POSITION. Now finishing five years' agreement. Good organiser, capable controller, keen and full of initiative, capable estimator and surveyor. An intensive worker with an exceptional experience. Sound practical and theoretical knowledge of the manufacture and maintenance of steam, gas, oil and Diesel engines, boilers, pumps, compressors, hydraulics, electric power generation, various classes of machinery, water well plant and road motors (steam and petrol).—Address, P1676, The Engineer Office. P1676 B

ENGINEER (33) SEEKS Responsible POSITION; used to control of staff, planning, tools, organising, &c.; shop experience, energetic, light engineering.—Address, P1663, The Engineer Office. P1663 B

ENGINEER, University Man, First-class Honours, wide works and field experience at home and abroad, sound knowledge design and commercial methods, can handle staff, highest references, ex-officer (age 39), REQUIRES POSITION of RESPONSIBILITY with firm of manufacturers or exporters.—Address P1716, The Engineer Office. P1716 B

HAVING Completed the Advancement of Home sales for a leading engineering firm by 50 per cent. in one year, ADVERTISER, M.I. Mech. E., A.M.I.C.E., OFFERS PERSONALITY and ABILITY in a MANAGERIAL or REPRESENTATIVE CAPACITY at home or abroad where co-ordination of manufacturing and sales effort is desired.
Address, P1652, The Engineer Office. P1652 B

MECHANICAL ENGINEER (27), Technical Education, apprenticeship, experience ashore, afloat and abroad, oilfields and marine, DESIRES POST abroad, erection and maintenance plant and general steam work. Drawing-office experience.—Address, P1714, The Engineer Office. P1714 B

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A Seven-Day Journal

Financing German Exports.

By carrying out a scheme whereby production costs will be reduced and facilities will be offered for exporting engineering products, the German Government is preparing the way for a competition in foreign markets which may influence appreciably the conditions of foreign trade. Already, with the collaboration of the banks, a system of credits has been inaugurated to enable German firms to do business with Russia. The Soviet Government requires two to five years' credit on all orders given out, and the system will be covered by a sum of 300 million marks. The banks will support 40 per cent. of the risk, the Government 35 per cent., and the Confederated States 25 per cent. Among the contracts to be executed for the Soviet is one for oil plant to the value of about 100 million marks. The export trade generally is to be aided by the creation of an insurance company which will accept risks on credits given to foreign buyers. Makers of railway rolling stock are to be provided with work, and to enable German coal to compete with British fuel in foreign markets export bounties will be accorded amounting to 70 or 80 million marks. At the same time the Minister of Finance proposes a notable reduction in the taxes affecting trade and industry generally. The tax on turnover will be lowered, and the luxury tax will be practically suppressed, while the taxes on companies will be reduced by one half. These remissions will relieve trade and industry by more than 600 million marks. The engineering industry has a production capacity so far in excess of home needs that it has been found necessary to adopt radical measures in order to save it from disaster.

The Cape Town to London Flight.

The London Terminal Aerodrome at Croydon presented an animated appearance on Saturday afternoon last, when an enthusiastic welcome was given to Mr. Alan Cobham and his two companions on their safe return from Capetown. Mr. Cobham's flight of over 16,000 miles to Capetown and back is another record for British aviation. The machine he flew was a de Havilland 50 which was specially equipped with a 385 horse-power Siddeley Jaguar radial air-cooled engine, which enabled the machine to take off from landing grounds at high altitudes. The homeward journey from Capetown was begun on February 26th, and over 8000 miles were flown in daylight, some twenty-six stops being made on the way. During the last two days Mr. Cobham accomplished over 1800 miles. On Friday he flew from Athens to Pisa, a distance of about 945 miles, in 9 hours and 40 minutes, and on Saturday, the last part of the journey, over the Alps from Pisa to Lyons, Paris and Croydon, some 855 miles in all, was covered. The machine was escorted from Sevenoaks by several others, but Mr. Cobham maintained a lead and landed at the aerodrome at 4.20 p.m. He appeared to be none the worse for his long flight. He paid high tribute to his mechanic, Mr. Elliot, and as regards the flight, said that the main thing was organisation and tenacity of purpose. It is of interest to note that the Union Castle Liner, Windsor Castle, left Capetown at the same time as Mr. Cobham, and although steaming night and day over a course of approximately 6000 miles, the ship only arrived at Southampton early on Monday morning.

The Preston Electricity Supply Station.

The Preston Town Council recently authorised application to be made to increase the £66,000, approved for electricity transmission lines from Preston to Blackpool to £87,500. The original scheme provided for carrying 10,000 kilowatts, whilst the new and larger scheme will be capable of dealing with 30,000 kilowatts, and will supply five coast towns with all the current they require for a considerable time to come. When the Preston Corporation took over the electricity supply undertaking, about three years ago, the gross revenue was £60,000, and the consumption was less than 4000 kilowatts. The station capacity has, however, now reached 8500 kilowatts, and when the Leyland load is taken over the output will be 20,000 kilowatts. With the extension now proposed the outlay on the undertaking will be over a million pounds. It is believed that the Corporation's Ribble Station will be one of the selected stations under the Government's new electricity scheme, and that in a few years time it will bear no resemblance to the present station as regards size.

Locomotives for South Africa.

Rumours to the effect that the American locomotives which the South African Government Railways recently obtained from the Baldwin Locomotive Works were not as perfect as they were supposed to be were declared to be untrue by Mr. Malan, the Minister of Railways, speaking at the beginning of this week in the South African Parliament. Not only was the performance of these engines excellent, he said, but the Administration was desirous of obtaining more if a suitable price could be arranged. Tenders, he added, had been invited all round. We understand that British as well as American firms have been asked to submit offers for the "Mountain" type of locomotive required, and that there are no grounds for the suggestion that they have been excluded because of their alleged inability to give delivery within the stipulated period. That meaning might easily be read into the report of Mr. Malan's remarks, published in the columns of a leading London journal, but it would appear that some confusion has arisen between the circumstances in which the order for the American engines now in service was placed and those of the tenders now being invited. The new tenders are, in fact, not returnable for a few days yet, and it is therefore not possible at present to say whether British builders can or cannot deliver the engines within the time allowed them.

An Engineering Amalgamation.

On Wednesday, the 17th inst., an extraordinary meeting of the shareholders of Mirrless, Bickerton and Day, Ltd., of Hazel Grove, Stockport, was held in Manchester, in order to sanction a scheme for that company's amalgamation with the already closely allied firm the Mirrless Watson Company, of Glasgow. It is claimed that the fusion of the two companies will promote efficiency, and that there is likely to be a better market for the shares of the combined undertaking. Under the proposed scheme the Glasgow Company will sell and transfer all its business and its assets to the Stockport Company, with the exception of its holding in Mirrless, Bickerton and Day, Ltd., which comprises a sum of £50,000 in cash and 36,000 shares. The purchase consideration will be 244,000 fully paid ordinary shares of the Stockport Company, which, together with the holding above mentioned, will enable the Mirrless Watson Company to give its shareholders seven ordinary shares of the Stockport Company for each of its own shares, and a capital repayment of 5s. per share in the event of liquidation and distribution of assets. The necessary increase in capital will be made by the Stockport Company, and the two boards of directors will be merged. Ordinary shareholders in the Stockport Company will receive a bonus of 2s. 6d. per share. The amount payable in respect of the 36,000 shares held by the Mirrless Watson Company will form part of the assets to be acquired by the Stockport Company. The meeting expressed its unanimous approval of the scheme.

Rebuilding the German Navy.

The German Navy Estimates for 1926, which have now been passed by the Reichstag, contemplate a total expenditure of £10,165,000. The heaviest item is represented by new construction, on which £2,705,000 is to be spent. This vote will enable work to be continued on the cruiser "B," now on the stocks at Wilhelmshaven, and on the twelve destroyers which are already under construction or about to be laid down. Two further cruisers, designated "C" and "D," will be laid down in the current year, and an experimental torpedo-boat is also to be put in hand. The building and completion of all these vessels will involve an outlay of £7,580,000, and when the cost of the Emden—a cruiser recently completed—is added, viz., £1,420,000, it will be seen that expenditure on ships for the new German fleet already totals £9,000,000. The three cruisers will be similar in design to the Emden, which is a vessel of 6000 tons, with turbine machinery of 46,000 shaft horse-power, and an armament of eight 6in. guns. The twelve destroyers are of uniform design, with a displacement of 780 tons, a speed of 34 knots, and an armament of four 4·1in. guns and four 19·7in. torpedo tubes. The first boat of the series was launched at Wilhelmshaven on March 4th, and named the Moewe. Provision is made in the Estimates for increased expenditure on ordnance and torpedoes and on fuel supplies for the fleet. The obsolete battleship Zähringen is being refitted to serve as a wirelessly-controlled target ship. The naval *personnel* numbers 13,161 officers and men, a figure that is 1839 below the maximum establishment permitted by the Treaty of Versailles.

Two More Cruisers Launched.

Two more cruisers of the 1924 programme were launched on Tuesday last, March 16th, the Kent at Chatham Dockyard and the Cumberland at the Vickers yard, Barrow-in-Furness. Both had been on the stocks from sixteen to seventeen months, and are due to be completed in the financial year of 1927. They are similar in design to the Suffolk, which was launched at Portsmouth on February 16th, and to the Cornwall, which took the water at Devonport on March 11th. The Berwick, the fifth and last ship of this initial group of "County" destroyers, is to go afloat at the Fairfield yard, Govan, on March 30th. These vessels were designed by Sir E. T. d'Eyncourt, and are understood to incorporate many novel features suggested by war experience. According to unofficial data which have been published, they differ from all our earlier cruisers—excepting only the cruiser-minelayer Adventure—in being flush-decked ships. In place of the usual tripod they will have a tower-like structure carrying the bridge and the fire-control stations. There are to be three funnels, of which the second will be larger than the other two. The main armament, it is added, will comprise eight 8in. guns, paired in turrets disposed on the conventional fore and aft system. The displacement is expected to approach the 10,000-ton limit permitted by the Washington Treaty. The second group of "County" cruisers—four in number—has been designed by Mr. W. J. Berry, the present Director of Naval Construction. Of these the London was laid down at Portsmouth on February 23rd and the Devonshire at Devonport on March 18th. The Shropshire and the Sussex are to be built by contract.

Threatened Engineering Lock-Out.

Following the suspension of the date on which the lock-out notices posted in the federated engineering establishments were to take effect, the executive representatives of the Amalgamated Engineering Union on Saturday, the 13th, met at Manchester the National Committee, consisting of members of the rank and file of the Union. That Committee, by forty-four votes to seven, endorsed the action of the Executive Council and recommended the strikers at Messrs. Hoe's establishment to resume work so as to avert the threatened national lock-out and allow the questions that have been the cause of the trouble to be discussed by the union representatives with the employers in a constitutional manner. It was anticipated that the strikers would not disregard this verdict of the National Committee, but at a meeting on Monday they declined to accept it and reaffirmed their decision to remain on strike until their grievances, on the score of non-unionism and wages, had been settled. They, further, expressed condemnation of the Amalgamated Engineering Unions and the action it had taken. On Wednesday the executive representatives of the seven unions involved in the dispute met the strikers, but without result, for the men continued obdurate and refused to waive a single item of their claims. At the moment of going to press the outcome is awaited of a conference between the employers and the Union's representatives.

The Future of the Motor Ship.

At the thirty-seventh annual meeting of the King Line, Ltd., which was held in London on Monday, the 15th, Lord Kylsant made some interesting comments on the possible future of the motor ship. As chairman of the company since its formation in Scotland thirty-seven years ago, he recalled the interesting early years of its development, and referred to his recent greatly increased associations, as the chairman of Harland and Wolff, Ltd., with the shipping, shipbuilding and allied industries in the West of Scotland. The British Empire, he said, was world wide in its power, and it should maintain a high level of mercantile marine power, both as regards its passenger liners and its cargo ships. He stated that many of those who were listening to his address would live to see the time when steamers would be as rare a sight on the high seas as was the sailing ship to-day. Although some owners were uncertain about the oil supply for motor vessels, he held that the motor ship had definite advantages as compared with the steam ship. Lord Kylsant further said that the present fleet of the King Line comprised nine steamships with an average age of seven years. As soon as the time came for renewal, he intended to make them all motor ships, as there was no doubt that the tramp motor ship was the vessel of the future. Associated with the King Line, Ltd., is the British Motor Ship Company, Ltd., which owns the two 400ft. 5200-ton motor cargo ships King James and King Malcolm, which were recently built by D. and W. Henderson, of Glasgow, and engined with six-cylinder Harland B and W. long-stroke oil engines.

Italian Motor Liners.

The recent news from Italy that four twin-screw motor passenger liners for a Brazilian firm are to be built at the Monfalcone Yard of the Cantiere Navale Triestino, and that the propelling machinery will be supplied by the Fiat Company of Turin, marks a further important order for the Italian shipbuilding and marine engineering industry. The Fiat motors will be, we understand, four-cylinder engines, of the two-cycle single-acting type, designed to develop 1750 brake horse-power at a normal speed of 125 revolutions per minute, giving a total shaft horse-power of about 3500. By increasing the speed of the engines to 133 revolutions, about 4200 horse-power will be developed. The auxiliary engines will comprise three 80 kilowatt Fiat Diesel-electric generator sets, and an emergency compressor and dynamo driven by a hot bulb engine. Considerable interest is attached to the single-cylinder experimental double-acting two-stroke motor, which has been designed by the Fiat Company for fast passenger liner machinery. It has a normal output of 2000 brake horse-power, at speeds varying from 120 to 150 revolutions per minute. The progress made by Fiat marine and land engines in Italy has recently been reflected in England by the appointment of Mr. D. M. Shannon, late of Cammell Laird and Co., Birkenhead, as the manager of the oil engine department at the London office of Fiat (England), Ltd.

Notes on British Railways by a Continental Engineer.

No. VII.*

ELECTRIFICATION.

ENGLAND is at one and the same time the country in which the electrification of its railways is the easiest to design and the most expensive to operate. The easiest because of the density of the railway networks or of their activity, and of the comparatively short lengths of the lines, and the most expensive because Great Britain is almost entirely without important water powers. It must produce all its electricity by the aid of steam. It is therefore of interest to inquire into the question as to whether, omitting suburban services and all other considerations, the conversion of the lines for electric traction would be useful or economical.

As a matter of fact, the country was among the first to electrify certain suburban lines, because, at first, at any rate, of the competition it felt from electric tramways. The London and Brighton Company was the first to take this step. It is easy to understand how much complication the employment of an overhead trolley system is likely to cause on suburban lines, and on busy lines with several pairs of rails, by reason of the multiplicity of conductor towers, &c. The Chemin de Fer de l'Etat Français is electrifying its busy and dense suburban lines on the third rail system. I am inclined to think that, more especially for journeys of short length, it is right.

PASSENGER TRAFFIC.

In spite of the advantages which it possesses for those who have tried it, I do not think that the system of working passenger traffic in Great Britain would immediately appeal to a stranger just arrived in the country and feeling a big lost. The continental passenger is accustomed to find himself more directed and more protected—at least he believes he is, but custom has warped his judgment—and especially is he accustomed not to trouble about his registered luggage. In England, left to his own devices, the traveller feels himself isolated and left out in the cold, a feeling which his ignorance of the language helps to intensify, and he does not always understand the object of this or that simplification, which, as a matter of fact, no one will take the trouble to explain to him. Furthermore, the continental traveller has accustomed himself to a day divided up into twenty-four hours instead of into two lots of twelve. The Parisian, too, has become accustomed instantly to the mode of working of his Metropolitan, which is run on entirely American lines—rapid, machine-like, and almost brutal—and on which stoppages are only made for a few seconds; in a word, he has got used to a method of working which is entirely different from that to which the other railways had habituated him, though it is true that in this particular case the delicate problem of luggage does not enter into the question. One is justified, therefore, in coming to the conclusion that the habits of the public are very quickly formed and modified.

Unfortunately, the continental railways, especially the French lines, suffer from some antiquated and hampering rules and regulations, which were only suitable for railways in their infancy. Numerous signals have to be made before a train can start; there is incessant whistling; the brake has to be tested every time a train is divided, &c. How poorly that compares with the working of the Metropolitan or of the electric tramways of the same country, which is, at least, as simple as that of the English railways. It is not, therefore, a question of race, but of superannuated legislation.

To the traveller who knows how to observe, Great Britain possesses great facilities. There is a multiplicity of trains in all directions; there are numerous junctions at which connections with other lines may be made; the stations are well arranged and readily accessible to the public; there is an absence of incivility in officials of all grades; the trains, which are not overcrowded, run quickly and silently; and there is an abundance of porters for all the trains. The traveller everywhere feels that he is at home and not that he is simply tolerated.

The arrangements for luggage are organised in a manner which is quite satisfactory for the traveller who is not infirm and who is used to fending for himself, but it does not give the feeling of security looked for by passengers accustomed to throw the responsibility for their belongings on the companies. Furthermore, the traveller in England takes with him more hand baggage and fewer large trunks than his counterpart on the Continent, and more especially in America, where registration of luggage is also in force though on a system which is entirely different from that used in Europe. In British stations you do not have to undergo the obligation of having all your luggage weighed as you leave on a journey, nor are there any *octroi* formalities to go through when you reach the end of it.

In fact, whatever may be said of it, the system must be highly practical since a terminus is completely emptied of passengers and their luggage within a few minutes of the arrival of a train, and the high platform certainly facilitates matters. The main line services on the Continent work equally well when there is no great crush of passengers, but the taxi-cabs cannot enter the stations and arrange themselves alongside the platforms, as they can in England, and the baggage must be carried or wheeled—through considerable distance, sometimes, in large stations—to a special room where the public has to wait for it; a complication which is to a large extent due to the *octroi*. Hence in the continental termini there is a movement to and fro of trucks, and a going and coming of baggage, which is practically unknown in the United Kingdom. At certain times, particularly at the beginnings and ends of vacation seasons, and on holidays, this system becomes defective, and the baggage accumulates in the reception rooms and the traveller is much delayed, though great progress has been made lately. In the English stations the baggage does not accumulate.

In the United States these inconveniences exist to a certain extent, but they are not objected to by the public because of the exceedingly efficient, cheap and practical service rendered by the Express Companies which make very small charges, such as have no real counterpart in Europe.

One of the points which goes to simplify the baggage question in England is that only personal luggage—trunks, baskets which can be fastened by lock, &c.—is carried in passenger trains, whereas the French companies are obliged to accept for registration articles of all sorts and descriptions, which may be handed in by the traveller—big chests, tools, trucks, &c. That constitutes an obligation which gives them very considerable trouble, but they have to put up with it.

It is a well-known and incontestible fact that the British companies have to pay annually as compensation for baggage or merchandise which has been lost or has gone astray, sums which are infinitely less than those which have to be paid by the continental companies, for example.

The provision of "through carriages" which are such a success in England, where, by means of decentralisation, passengers are able to make cross-country journeys or travel to or from north to south without having to traverse London, is worthy of much commendation and is exceedingly practical. The system is very highly developed, as will be realised when it is said that an express from Glasgow to London—to confine myself to just one example—will include at least one composite coach—first and third-class—for Birmingham, the South Coast, and so on. These coaches are always confined to the same journeys, and never sent by other routes, and they carry on their upper parts boards inscribed with the name of the stations they connect or stop at, so that a traveller can tell which coach he should take without having to ask any questions.

The longer the trains, and the shorter the stops the more composite coaches are useful, the traveller finding the class of compartment he desires close to him in whatever part of the platform he may be standing when a train comes in. The employment of this type of coach is much easier on the railways of the United Kingdom than on the Continent, for there are only two classes of compartment. But in order that they may reach the goal aimed at it is necessary that there should be a large number of these coaches, that their use should be general, and that the public should be made aware that they form parts of the trains that they propose to travel by.

Through carriages were at one time tried in France, but the results obtained were not very satisfactory, saving on international trains, first of all because the number of travellers was not sufficient, and then because the small coaches used, since there were no composite coaches, had to run on branch lines not equipped for the use of express trains, whereas in England all the lines are good and run on the block system.

In the United Kingdom the platforms, whether arrival or departure, are generally accessible to the public,† without any examination of tickets, which is done entirely in the coaches. There is a complete absence of railway servants other than porters, which means a sensible reduction in the staffs, but in some of the termini there are special policemen to direct vehicular traffic and to maintain order.

There are no gold-braided officials, and one cannot see where the orders come from. The guard, whose duties are more complex and onerous than those of his *confrère* on the Continent, gives, from his own initiative, the signal for the train to start by waving a small flag, or by a motion of his hand. In short, it is the guard who does everything. This method of working, which dates from the very beginnings of railways, has always given good results. Everything is done quietly, without whistling, without verbal orders or discussion, with complete orderliness, and it is noteworthy that the relations between the public and the railway officials of all grades are always most cordial.

In the goods stations matters go on in the same way. Thanks to the excellent equipment, the *personnel* seems to be adequate everywhere. Wrong movements are rarely made, and every man seems to be in his proper place during working hours. The goods station is an establishment in which all the various operations are carried out with regularity and method.

To one who is accustomed to the continental system, and to the continual presence of the *chefs* and *sous-chefs de gare*, the working of the British stations seems to be automatic; even the making up or splitting up of trains requires fewer orders given or received, and entails less loss of time than is the case elsewhere when only a single coach is being dealt with. The responsibility rests on the guards and drivers.

If the official statistics did not prove how numerous are the passengers conveyed annually on the British railways, it would be hard to believe that the numbers are as great as they are, for except on some week-ends in the summer and on Bank Holidays, one seldom sees the main line trains really crowded. There always seems to be room for more passengers even in the third-class compartments. This fact, which appears to be paradoxical in a country so densely populated, must certainly be due, to a large extent, to the number of lines running more or less parallel with one another, and to the numbers of trains starting at about the same hours, but it is also largely due to the rapidity with which both passengers and baggage are evacuated from the trains and stations. All members of the *personnel* attend strictly to their own jobs. The drivers are on the alert to get their trains away as soon as the signal is given, and the guards give that signal at the earliest possible moment. But the passengers have to be on the look-out, as drivers start without notice. Even the Americans are not used to such cold-blooded working. The running of local trains is very closely timed, and does not admit of any unnecessary delays. The ideal of the English companies is not so much to have their trains crowded, and utilise them to the best possible extent from the point of view of dead-weight, as to give their passengers satisfaction. The coefficient of exploitation is evidently rather high, but the receipts per train-mile are also high, and reasonably enough much less effort is made to reduce the former than to increase the latter.

Suburban services in England, and particularly in the London area, have been very highly organised for more than the last fifty years. On the lines, which are even now numerous, that are still worked by steam locomotives, the services are well conducted; the trains run frequently, they get away quickly, and their average running speed is very fairly high. The coaches of the set trains have for some time now been coupled together with links and pins—a simplified form of central coupling—and the distance between adjoining coaches is small, which results in a saving of length of platform occupied of some 20 per cent. as compared with continental practice. The set trains are never split up—saving when repairs are necessary—which does away with a great deal of shunting, saves waste of time, and keeps the lines free. An excellent system.

Very long stopping and suburban trains are not desirable, for they are likely to lead to station stops longer than necessary, the public passing up and down seeking compartments of the class for which they have tickets, and that means a lot of coming and going. Much less inconvenience is caused by having only two classes, as has been done on certain lines running into Paris for their suburban traffic, with this difference, that they have suppressed the third-class and not the second-class as in England. But the high platforms render great service from this point of view, for the travellers can see immediately in which compartments there are vacant seats. It is difficult to understand why the high platform which is so practical and renders possible such a reduction in the lengths of stops, and makes it so much easier for slightly infirm passengers to enter and leave the coaches, should be so little used abroad.

It would be impossible in a general article of this kind to give a critical comparison between train speeds in Great Britain and those of other countries. Such comparisons are frequently made, but they are without the limits which the writer has set for himself. He contents himself, therefore, by referring the reader to what he has already said on the subject. England is no longer the sole holder of the speed records for main line express trains, for France and the United States of America both possess a large number of them, but she probably still remains the country in which the average speed of all kinds of trains is highest.

It is only fair to remark that the grant for a, so to speak, indefinite period of their lines and installations, taken in conjunction with their high receipts per mile, and the relative liberty which they enjoy, should give to the English companies a breadth of view that one would not find anywhere else in Europe. On the other hand, since they are entirely private undertakings, their enormous capital expenditure calls for economical management, but, as has been said, more attention is paid to increasing the receipts than to effecting a series of small economies.

THE Bill of the London Electric Railway Company provides for a single station, with escalators, at the Elephant and Castle to replace the stations of the City and South London and the London Electric Railways.

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* No. VI. appeared March 12th.

† Except some London termini for southern lines.

The Flow of Water Through Soil.

THE great plains of North India, composed as they are of sand or clay, alluvially deposited by the rivers Indus and Ganges, present facilities for the scientific study of sub-soil hydraulics which have been less utilised during the past hundred years than one could wish; though fragmentary investigations have been

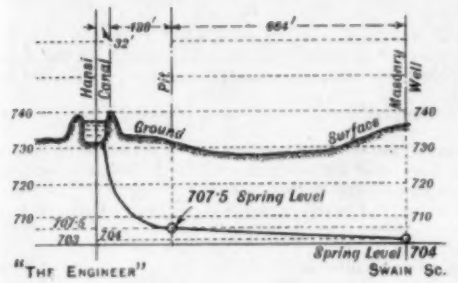

FIG. 1

made, from time to time, by various individuals. Early in the year 1898 some experimental observations were made at Jind, on the Hansi branch of the West Jumna Canal in the Punjab, which revealed soil and subsoil water conditions somewhat as depicted in Fig. 1.

There was a masonry well to the right of the canal, and distant about 850ft. or 950ft. from its water edge.

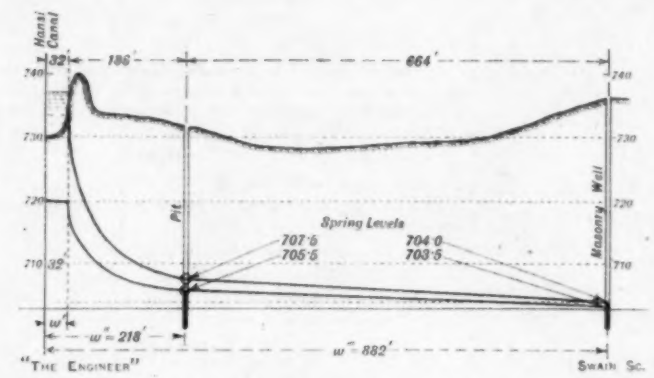

FIG. 2

An experimental pit was dug down to subsoil water level at a point about 186ft. from the right water edge of the canal, and daily observations were recorded of the water level in the pit and in the masonry well. The water level in the pit was about 3·5ft. higher than in the well; which indicated that percolation flow passed from the canal to the pit, and thence to the well, down a gradient curved somewhat like a

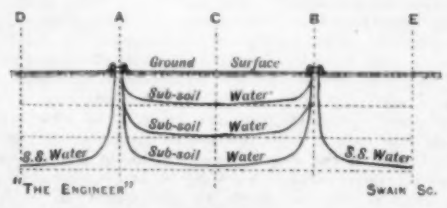

FIG. 4

hyperbola. The canal was closed for seventeen days from February 18th, 1898, and ran dry, and the pit also became dry, through sinkage of water level. On March 6th the canal was reopened, and remained in flow for twelve days.

During that period the water level in the pit rose at the average rate of 2in. daily. The rise of water level in the masonry well was much less. It could not

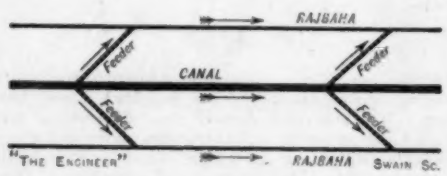

FIG. 5

be determined with precision, as water was drawn daily from the well for drinking and domestic purposes; but it was less than 1in. per diem, and probably not more than ½in. per diem, after allowing for the draught on the well.

The fact that the daily rise or fall of water in the pit, and in the well, respectively, was about inversely proportionate to their distances from the canal, suggested that the gradient of percolation flow was curved hyperbolically, as shown in Figs. 1 and 2.

We may regard the percolating stream as flowing vertically down, through horizontal waterways whose widths were $w' = 32$ft., $w'' = 218$ft., and $w''' = 882$ft. respectively, the respective velocities being v', v'', and v'''. Then, since the discharge was constant, we may conclude that $w'v' = w''v'' = w'''v'''$, where v represents generally the rate of vertical descent, or of sinkage, per diem, of the subsoil water surface on a vertical distant w feet from the centre line of the canal. Thus, from Fig. 2 we may deduce that if $v'' = 2$in. per diem at the pit, $v''' = 0{\cdot}5$in. per diem at the well, and $v' = 14$in. per diem through canal bed. With suitable arrangements, the volume of percolation flow from a canal at any point of its course might be determined in this manner, the mean wetted perimeter of the channel—bed width plus half the side slopes—being known.

Fig. 3 illustrates the soil and subsoil water conditions under and on either side of the Hansi Canal, as recorded along a line transverse to the canal, about 4 miles upstream of the site of the experiment illustrated in Figs. 1 and 2.

At a distance of 8 or 9 miles from the canal, to right and left respectively, the subsoil water levels were, in the year 1898, about 133ft. or 123ft. below ground surface; but from there, canalwards, the water table rose steadily up to canal bed level, as the result indisputably of percolation flow from the canal.

Careful measurements of the flow of the canal had been made at points 20 miles apart, and results obtained which indicated excessive percolation losses; but the Chief Engineer, Irrigation Works, Punjab, of that day—who happened also to be a hydraulician of world-wide fame—had rejected those conclusions,

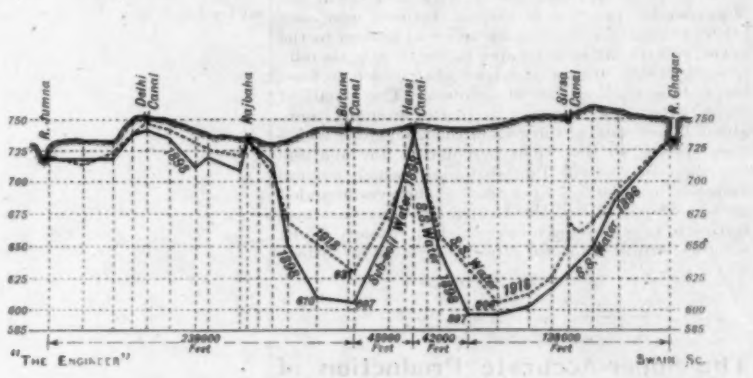

FIG. 3

on the ground that this portion of the canal lay in good clay soil, of less than average porosity. The experiment above described was carried out in order to verify matters; but, even apart from that, the statistical records of the period, as exhibited in Fig. 3, afford indisputable proof of the abundance of percolation flow from the canal.

From these and other similar data of observation, the writer inferred that the percolation from any flowing stream sets up a ridge of saturation in the soil beneath it, which is an effectual bar to subsoil water flow across the vertical plane of the stream line; just as an earthen embankment on the ground surface may prevent surface flow across it.

In the latter case, the surface drainage may be passed across the embankment through a culvert or syphon built in the bank; but in the case of subsoil flow, the velocity of flow is usually so small as to render artificial drainage through the water barrier impracticable. The writer illustrated his ideas with a sketch like that in Fig. 4.

Let A and B represent two branches of a canal system, flowing roughly parallel to each other, in an alluvial plain bounded on either side by a river also roughly parallel. The subsoil water table will, under normal conditions, slope downwards, and then outwards away from each canal, in curves probably hyperbolical. The percolation from canal A will have free drainage to the left, towards D, and that from canal B will have free drainage to the right, towards E. But between the two canals, the transverse percolating streams will oppose each other at C, and the subsoil water will tend to stagnate and to well-up there.

There will still remain open a subsoil waterway in the direction parallel to the canals, downstreamwards, and as the subsoil water level at C rises, the percolating stream will obtain ever-increasing steepness of gradient in this direction; and increase of drainage flow up to a degree that may establish equilibrium and fair constancy of subsoil water level at C. But if a branch water channel be conducted across from canal A to canal B, or *vice versâ*, by way of supplementing the flow of either canal, this cross-channel will set up a transverse subsoil water ridge, which will obstruct subsoil drainage in the direction parallel to the canals, and will tend to waterlog the tract between the two canals and upstream of the cross channel.

Such conditions have been only too common in Indian canal designs of the past. An outstanding feature of Sir Proby Cantley's design for the Ganges Canal system was as shown in Fig. 5.

On either side of the main canal, and aligned parallel to it, at a distance of a few miles, were channels of 40 cusecs capacity, called "rajbahas." At intervals of from 5 or 6 miles along the main canal "feeder channels" passed from canal to rajbaha at an angle of 45 deg., making the canal system, in plan, a reticulated pattern of quadrilaterals, forming closed embankments above the ground surface, and closed ridges of saturation in the subsoil. Swamps formed on the ground surface; and to drain them off, either the rajbahas were done away with where they crossed

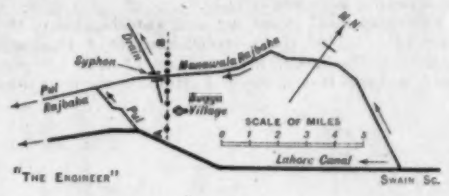

FIG. 6

depressions of the land—which was a sound remedy—or else syphon culverts were built under the channels for the drainage of surface swamps—a remedy which was not so sound.

The obstructions existing in the subsoil water table do not appear to have received recognition; the drainage only of the water standing above ground surface being aimed at.

The practice of tailing channels of a canal system into one another, so as to form closed circuits of flowing streams, was frequently adopted in the older canals of the Punjab. One example of this practice is illustrated in Figs. 6 and 7. The Lahore Branch Canal and its offshoots, the Mana and Pull Rajbahas, formed such a closed circuit, and the village of Bugga, within the enclosure, suffered badly from swamping.

An artificial drain was dug, passing under and across the Mana Rajbaha by means of a masonry syphon. It served to drain off the surface water of the swamps, but left the subsoil water unaffected. A line of wells or pits, dug along A B, Fig. 6, showed the subsoil water conditions depicted in Fig. 7. There was very little water flowing in the Rajbaha at this section—it was less than half a foot deep—

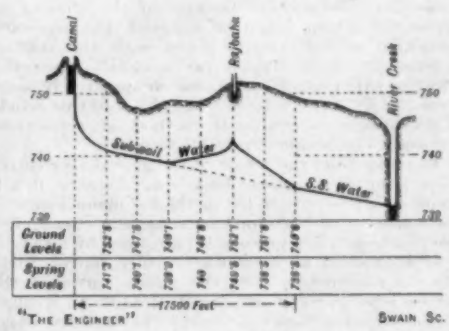

FIG. 7

yet its percolation had a very marked effect on the subsoil water table.

Fig. 8 exhibits a vertical section (looking upstream) of the Bari Doab, with subsoil water conditions as the writer found them in the year 1905. This section cuts the Lahore Branch Canal about two miles downstream of the site of Fig. 7.

The effect on the water table of percolation from the canal system was most marked. It will be noticed that the subsoil water was held up to a high level between the main canal and its principal branches, but outside the canal system it drained down steeply to the adjacent river valleys. There were many water channels crossing each other and forming closed circuits of subsoil stagnation. Remedial measures were proposed and sanctioned, but operations were delayed, and in the "wet" years 1908 and 1917

extensive damage was done to agricultural property and to public health.

In 1917 this subsoil water—see Fig. 8—rose up to or above ground surface throughout the tract, 29 miles wide, lying between the Lahore and Kasur branches of the canal. The monsoon rainfall (June to October) that year amounted to 36in. Supposing that half that water percolated into the soil, and supposing the soil porosity to be 25 per cent., it would account for a rise of subsoil water by from 6ft. to 10ft.

The Sobraon Branch Canal has less effect on the subsoil water than the other branches, because it flows during the summer only.

The calamitous swamping and waterlogging of the year 1917 led to the establishment of a Drainage Board for the special investigation of drainage projects, and this Board adopted generally the principles

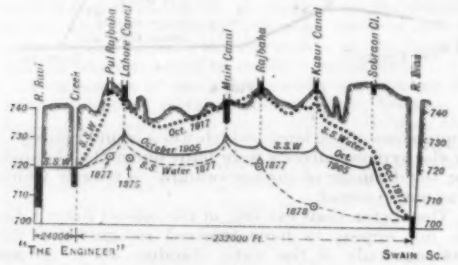

FIG. 8

of remedial treatment indicated as advisable in this article.

In the United Provinces of Agra and Oudh the objectionable practice of tailing channels into each other, so that the upper may serve as feeders to the lower, and the latter as escapes to the former, thereby forming closed circuits of subsoil obstruction to flow, has not been altogether abandoned. The canals of those Provinces, however, irrigate annually only about 16 per cent. of the area of the tracts over which they spread, so that their percolation flow matters less than that of the Punjab Canals, which irrigate annually from 30 to 70 per cent. of their commanded areas. The Doabs of the United Provinces are also fortunate in possessing numerous deep ravines, which serve as natural drains for subsoil, as well as for surface flow.

The Super-Accurate Production of Spur Gears on the Gear Shaper.

By H. WALKER, B.Sc. (David Brown and Sons (Huddersfield), Ltd).

THE complex nature of the formation of the gear shaper cutter, complex mainly because of its cutting reliefs, leads to many corresponding complications, some trivial and others of more or less vital importance, in the production of spur gears. Not the least of these is the effect of sharpening or grinding back the cutter on the tooth thickness and depth of the gears produced. It can be shown that when a partly ground cutter is used to generate a gear, the necessary cutting depth to give correct tooth thickness will be different from that which would be required from a new cutter unreduced in diameter by grinding the front face. Either through ignorance or neglect of these facts, or perhaps because of the amount of calculation which would be involved, the necessary correction is not usually given with the cutting instructions, even though for moderate cases the effect of this neglect may cause comparatively large errors, as will be seen later. The object of this article is to present a graphical method of correction, reduced to its simplest possible terms.

To understand the action of the gear shaper cutter when it has been ground back some distance, it will be necessary to refer to the method of manufacture of the cutter. The last operation on the cutter, *i.e.*, the profile grinding process, is performed by means of a straight-sided abrasive wheel which moves, rack-like, in conjunction with the pinion cutter at the correct relative speed necessary to produce an involute of the required base diameter. The abrasive wheel is usually trued up at right-angles to its axis, which is tilted over at the required pressure angle. A flat plane surface is thus obtained, and, it being sufficient to cover the entire face width of the cutter, the only movement required is the rack and pinion motion already referred to. The relief on the side of the cutter tooth is obtained by tilting the plane face of the abrasive wheel slightly out of parallel with the cutter axis. It will be seen that a straight line of constant slope, representing the side of a rack tooth, is presented to the profile of the cutter at every section. Consequently, the base diameter will be constant for every section, and this is, of course, essential if the cutter is to generate the same involute when cutting at different sections. The top relief angle of the cutter is made to correspond to the side relief angle in such a manner that if the enveloping rack for the front section of the cutter were meshed with any other section, the teeth of the cutter at this section would enter the rack teeth to the same depth as would the teeth at the front section. In other words, any section of the cutter is, compared with the front section, a pinion of short addendum and long dedendum, and its tooth thickness is governed in a similar manner to that of any corrected gear generated by means of a hob or rack cutter. Thus, if the pitch line thickness of the cutter at the front section is $\frac{P}{2}$, and if a section be taken where the addendum has been decreased by a distance x, due to top relief, the pitch line thickness at this latter section would be—

$$\frac{P}{2} - 2x \tan \text{pressure angle}.$$

It is obvious that the cutter would generate a rack of correct thickness and depth at any section within its working limits; but it does not follow that the same thing occurs when cutting gears other than the rack or when cutting corrected gears. The necessary cutting depth to give correct thickness on any gear may be found as follows:—

Notation—

- R_c = Pitch radius of cutter.
- R_g = Pitch radius of gear.
- P = Pitch of cutter.
- ψ = Pressure angle of cutter.
- x = Reduction on radius of cutter due to sharpening.
- C = Amount of correction on gear.
- r_c = Pitch radius of cutter when generating the gear.
- r_g = Pitch radius of gear when being cut.
- ψ_c = Pressure angle at which the gear and cutter mesh when at full depth.

Fig. 1, which shows the cutter and gear in mesh, will make clear the meanings of the symbols r_c, r_g

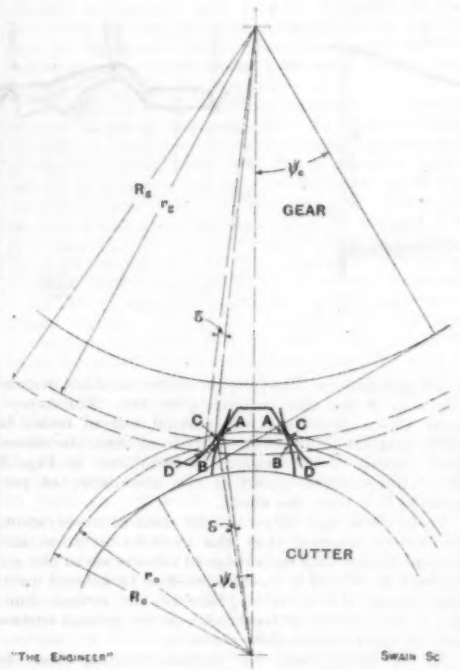

FIG. 1

and ψ_c. Owing to the reduction in diameter of the cutter, or to the addendum correction on the gear, the standard pitch circles R_c and R_g do not touch. The new pitch circles r_c and r_g are fixed by the ratio and centre distance, and are proportional to each other in the same proportion as the standard pitch circles—that is

$$\frac{r_c}{r_g} = \frac{\text{teeth in cutter}}{\text{teeth in gear}} = \frac{R_c}{R_g}$$

The change in centre distance also varies the slope of the common tangent to the two base diameters, the pressure angle being governed by the equation—

$$\cos \psi_c = \cos \psi \frac{\text{standard centre distance}}{\text{cutting centre distance}} = \cos \psi \frac{R_c + R_g}{r_c + r_g}$$

In the figure, the gear has been given a short addendum or negative correction, and, owing to it, the cutting centre distance is less than that which would obtain for a standard gear. The same reasoning, however, applies to the case in which the gear is given a positive correction, and also applies when the cutter is made large in diameter, as is sometimes done to prolong its effective life.

As previously explained, the tooth thickness A A of the cutter on the pitch circle R_c is $\frac{P}{2} - 2x \tan \psi$. The angle which is subtended by this arc at the centre of the cutter is $\left[\frac{P}{2} - 2x \tan \psi\right] \div R_c$ radians, and the angle subtended by the arc B B on the pitch circle r_c is $\frac{\frac{P}{2} - 2x \tan \psi}{R_c} + 2\delta$, where $\delta = (\tan \psi - \psi) - (\tan \psi_c - \psi_c)$, from the properties of the involute. The tooth thickness B B is therefore equal to—

$$r_c \left[\frac{\frac{P}{2} - 2x \tan \psi}{R_c} + 2\delta\right]$$

and this is the width of space C C, which will be generated on the conjugate pitch circle r_g of the gear.

Now, the width of space D D on the pitch circle R_g of the gear is $\frac{P}{2} + 2C \tan \psi$ (making it the same as that which would be generated by a rack type cutter or hob, and knowing that this thickness would be conjugate with that of a gear corrected by the same amount, but in the opposite direction). This width of space subtends an angle of $\frac{\frac{P}{2} + 2C \tan \psi}{R_g}$ at the centre of the gear, and subtracting 2δ (δ will be seen to have the same value as before) from this and multiplying by r_g we get

$$CC = r_g \left[\frac{\frac{P}{2} + 2C \tan \psi}{R_g} - 2\delta\right]$$

which must be equal to the expression already obtained for B B. Equating these two expressions and knowing that $\frac{r_c}{R_c} = \frac{r_g}{R_g}$ the equation reduces to

$$\delta = \frac{(x + C) \tan \psi}{R_c + R_g}$$

It can be proved in a similar manner that in the case of a corrected pinion, in which the correction C is greater than the reduction x, the equation becomes

$$\delta = \frac{(C - x) \tan \psi}{R_c + R_g}$$

δ now being equal to $(\tan \psi_c - \psi_c) - (\tan \psi - \psi)$.

In a similar case where C is less than x, the equation becomes

$$\delta = \frac{(x - C) \tan \psi}{R_c + R_g}$$

in which $\delta = (\tan \psi - \psi) - (\tan \psi_c - \psi_c)$. The general expression to cover all cases is

$$\delta = \frac{(x \pm C) \tan \psi}{R_c + R_g}$$

C being reckoned positive for the wheel and negative for the pinion, and δ being always equal to $(\tan \psi - \psi) - (\tan \psi_c - \psi_c)$.

By assuming values of ψ_c, different values of δ may be calculated for a given value of ψ, the pressure angle of the cutter. Values of $x \pm C$ may then be calculated to correspond to assumed values of $R_c + R_g$ and the values for δ already found. These results may be plotted as in Fig. 2, which is for a pressure angle ψ of 20 deg. The vertical scale represents $x \pm C$ and the horizontal scale $2(R_c + R_g)$, *i.e.*, the sum of the diameters of gear and cutter. The straight lines radiating from the origin give the values of ψ_c corresponding to any given combination of R_c, R_g, and $x \pm C$. Thus it is possible, given the diameters of the gear and cutter, the reduction in diameter of the cutter, and the amount of correction, if any, on the gear, to find the pressure angle ψ_c at which the gear and cutter must operate to give correct tooth thickness on the gear. Now, the angle ψ_c fixes the cutting centre distance for the gear and is related to ψ the initial pressure angle by the equation

$$\cos \psi_c = \cos \psi \frac{R_c + R_g}{r_c + r_g}$$

as already shown.

This equation may be expressed as

$$\frac{(R_c + R_g) - (r_c + r_g)}{R_c + R_g} = \frac{\cos \psi_c - \cos \psi}{\cos \psi}$$

and since the numerator of the left-hand side of the equation is equal to the variation in centre distance caused by the deviation of the gear and the cutter from standard diameters, we have: Alteration in centre distance

$$= (R_c + R_g)\left(\frac{\cos \psi_c - \cos \psi}{\cos \psi}\right)$$

Had the gear been cut to standard depth, the alteration in centre distance from standard would have been $x \pm C$, and consequently the difference between the alteration given in the equation above and $x \pm C$ gives the depth correction which must be given to the gear in order to obtain correct tooth thickness. These facts can be embodied in the chart in Fig. 2 in the following manner:—

Assuming a definite alteration in centre distance and working out $\frac{\cos \psi_c - \cos \psi}{\cos \psi}$ for each value of ψ_c given by the sloping straight lines on the chart, the corresponding value of $R_c + R_g$ can be calculated, and, joining the points thus obtained, the result will be a curved line for each assumed alteration in centre

distance; the ordinates from a point on one of these lines will represent the values of $2(R_r + R_p)$ and $x \pm C$, which necessitate the alteration in centre distance indicated by the line. From this must be subtracted $x \pm C$ to give the correction in working depth for the gear.

A similar chart is plotted in Fig. 3 for gears of 14½ pressure angle.

The correction is obviously independent of the pitch of the gears, and also holds good whether the tooth depth be standard or stub.

An example will make the method of application quite clear. Suppose it is required to cut a pair of gears having sixteen and fifty-six teeth, 8 D.P., 20 deg. pressure angle, 2in. and 7in. pitch diameters, the pinion having a correction of 0·06 (long addendum) and the wheel having a correspondingly short addendum, to be cut by means of a 3in. diameter gear shaper cutter ground to such an extent that its diameter is reduced by 0·060in. (*i.e.*, $x = 0{\cdot}030$).

For the wheel we have $x + C = {\cdot}090$ and the sum of the diameters of wheel and cutter = 10in. Projecting from these points on the scales, the ordinates meet at the point *a*, which lies on the line indicating 0·100in. alteration in centre distance. Owing to the correction on the wheel and the reduced diameter of the cutter, the centres would usually be closed 0·09in. from standard, and the additional 0·010 represents the amount which must be added to the working depth of the gears in order to obtain correct thickness.

For the pinion $x - C = -0{\cdot}03$ and sum of diameters = 5in. The ordinates from these points meet at *b*, and by interpolating between the values of 0·03 and 0·02, indicated by the nearest of the curved lines above and below this point, we obtain an alteration in centre distance of 0·028. The standard alteration being 0·03, the difference 0·002 must be added to the standard working depth of the gear.

The depths for pinion and wheel could be equalised, if necessary, by adding $\frac{0{\cdot}010 + 0{\cdot}002}{2} = 0{\cdot}006$ to the standard depth for each gear.

If no correction were given to the gears, $x \pm C$ would be equal to 0·03 for both gear and pinion, and the correction for both gear and pinion would be found from the upper half of the chart, in which case the depths for both gears would be increased. From the chart the pinion tooth depth would be increased by 0·002 and the wheel tooth depth by 0·001.

If the cutter had been of unreduced diameter, $x \pm C$ would be equal to 0·06 for the wheel and $-0{\cdot}06$ for the pinion. These values give an increase of 0·003 on the wheel tooth depth and an increase of 0·006 on the pinion tooth depth.

THE London, Midland and Scottish Railway Company spent £9456 from capital on track circuits, telephones and telegraphs last year. This year it is proposed to spend £74,000 and subsequently, until completion, £29,000.

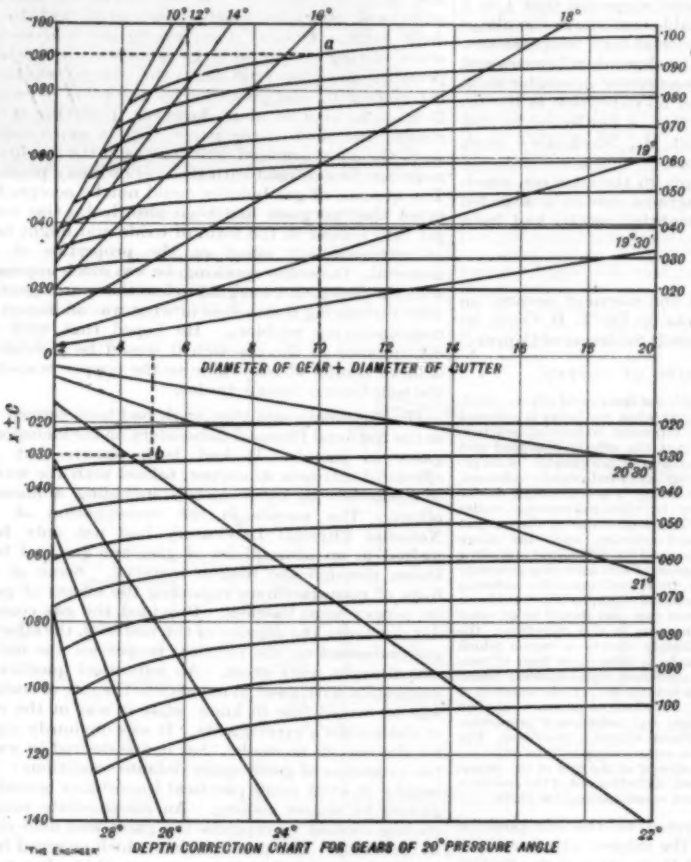
10° 12° 14° 16° 18°
a
19° 19°30'
DIAMETER OF GEAR + DIAMETER OF CUTTER
x ± C
b
20°30' 21°
26° 26° 24° 22°
"THE ENGINEER" DEPTH CORRECTION CHART FOR GEARS OF 20° PRESSURE ANGLE

FIG. 2

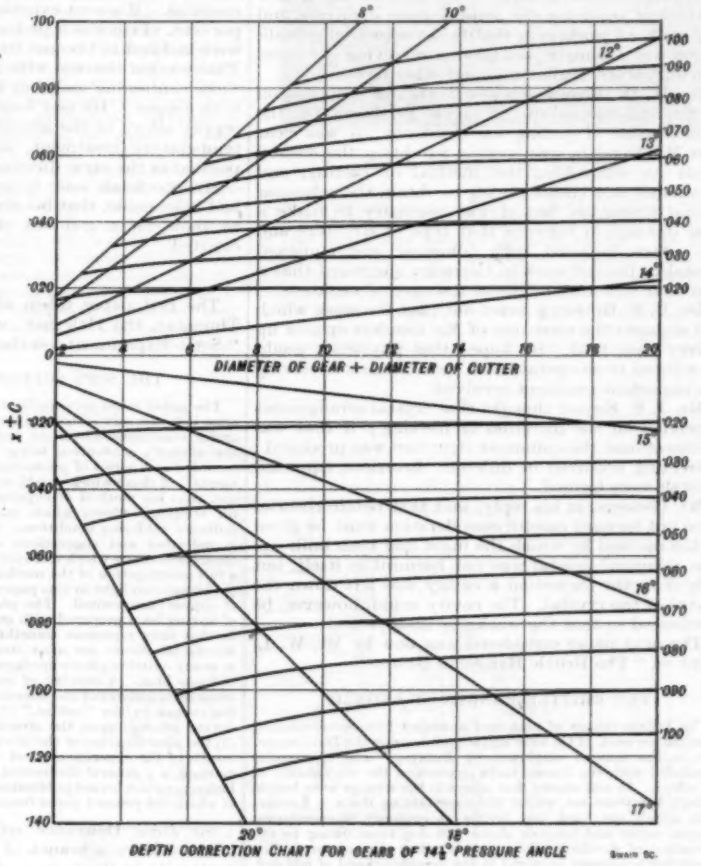
8° 10° 12° 13° 14° 15° 16° 17°
DIAMETER OF GEAR + DIAMETER OF CUTTER
x ± C
20° 18°
DEPTH CORRECTION CHART FOR GEARS OF 14½° PRESSURE ANGLE
Swain Sc.

FIG. 3

The Institute of Metals.

No. II.*

PROCEEDINGS at the afternoon session on March 10th, at which Sir John Dewrance presided, opened with the presentation of a paper by Dr. W. Feitknecht on "Crystal Growth in Recrystallised Cold-worked Metals."

CRYSTAL GROWTH IN RECRYSTALLISED METALS.

The experiments described in this paper deal with the changes of structure in cold-worked metals after recrystallisation is completed. They were mainly carried out with pure commercial aluminium (99·6 per cent.), but some work was also done with very pure aluminium (99·98 per cent.) and pure assay silver. It is shown that, after recrystallisation was completed, all further changes of structure on prolonged annealing were due to the growth of existing crystals, both when the temperature was kept constant and when it was raised. No crystals were observed to start from new nuclei. No relation between the size and shape of the crystals and the capacity to grow could be detected. The growth was faster, the more severely worked the sheets had been before recrystallisation. The final size that the crystals reached after growth had come to a standstill increased with decreasing deformation. In the pure commercial aluminium, in the moderately worked samples, very large crystals were formed. Below a certain limit of deformation no considerable change took place after recrystallisation was completed. A previous heat treatment at a certain temperature had a considerable effect upon subsequent growth at another temperature and upon the final crystal size. In sheets thinner than 0·75 mm. the crystal size decreased with decreasing thickness of the samples, and in very thin sheets no considerable growth took place after recrystallisation was completed. In the very pure aluminium the growth was much quicker than in the pure commercial aluminium. The pure assay silver behaved much like the very pure aluminium, but the crystals did not grow so large. An endeavour is made by the author to explain the observed facts by assuming that the crystals formed during recrystallisation were still strained, and that on heating further the least strained crystals absorbed the crystals having the most remaining strain.

Miss Elam, speaking from knowledge of the work described by the author while it was in progress, said that a very large number of specimens had been dealt with during the investigation. With regard to the growth of crystals after recrystallisation, such growth was undoubtedly connected with strain, and subsequent changes were due to the amount of work done. The phenomena appeared to be governed by some kind of law, and it was interesting to find that the results of the author's research confirmed what had been noted by other workers in the same field. It was proved that small crystals could grow to a large size.

Dr. W. Rosenhain welcomed the paper as containing a large amount of new data on the crystal growth which occurred in aluminium and silver under various conditions. One of the points made as to the growth of crystals after recrystallisation might be connected with a phenomenon discovered in some work carried out recently in Germany on the annealing of cold-worked silver. The author put forward a theory of residual strain, but there was no evidence in support. In seeking for the true explanation of crystal growth, it was the study of the boundary of the crystal which was important. He was not satisfied that internal strain was the sole explanation.

Colonel N. T. Belaiew also emphasised the need of investigating the crystal boundaries. At certain temperatures and under a particular set of conditions changes might take place.

Mr. U. R. Evans said that Dr. Feitknecht had cleared up one or two points in connection with crystal growth, and he accepted the view put forward in the paper as being a probable explanation of the principal facts. There were some phenomena for which, however, there was no obvious explanation. In some cases the original grains disappeared during recrystallisation, but on further heating new grain growth took place. Average grain size was less dependent on deformation at high than at low temperatures.

The author will reply to the discussion by correspondence.

Then followed a paper by Mr. R. Genders on "The Interpretation of the Macrostructure of Cast Metals."

THE MACROSTRUCTURE OF CAST METALS.

The interpretation of the structure of cast metals and alloys has depended mainly on empirical observation. While in the case of steel the macrostructural characteristics of a casting give definite information regarding casting conditions, the same indications cannot be applied directly to cast specimens of non-ferrous alloys, particularly to those consisting largely of copper, which solidify rapidly. The work described has the aim of establishing grounds upon which a more general interpretation of the macrostructure of metals, and consequent knowledge of the mechanism of the solidification of a casting, can be based. In copper alloys of high thermal conductivity solidification occurs concurrently with pouring, and the flow of metal within the mould becomes of primary importance in governing the mode of crystallisation. Experimental slab ingots, 12in. by 6in. by 1in., were made of two alloys of similar physical characteristics but of different colour, melted in separate crucibles. By the use of a specially designed pouring trough the metal passed into the mould in an unbroken stream, while the alloy comprising the stream could be changed at any pre-arranged stage by varying the amounts of metal in the two crucibles. The disposition of the colour zones distinguishable on sections from the ingots indicated that the process of formation of the ingot from the stream was one of continuous displacement of metal in the path of the stream to the faces of the mould. Several sets of casting conditions, covering most of those used industrially, were included in the experimental work. The conclusions drawn concerning the mechanism of the formation of a casting, permit of the interpretation of many peculiar features observed in the structures of ingots of copper alloys. The effect on macrostructure of the temperature range over which the alloy solidifies is considered, and the theory accounting for the formation of equi-axed crystals by concentration variations in the region of the liquid-solid interface is developed and applied to a number of practical cases. In all metals having no freezing range, cast by ordinary methods, a completely columnar macrostructure is formed unless special precautions (which can be prescribed) are taken to avoid it. The method for determining the mode of formation of the casting by the use of two alloys is applicable industrially in connection with the design of moulds and casting methods.

Dr. S. W. Smith congratulated the author on experimental work which had added a valuable chapter to the knowledge of what happens during the pouring of metals into moulds. The investigation showed the link between solidification, composition and macrostructure.

Dr. D. Hanson was able to say that the work done

* No. I. appeared March 12th.

in the same field for the Non-ferrous Metals Research Association confirmed Mr. Gender's conclusions. It was not at all easy to regulate the type of structure in casting small chill bars for rolling, and difficulties had been experienced in obtaining the columnar form of crystals in small chill castings.

Colonel Belaiew asked that the value of the paper might be increased by the addition of time and cooling curves, as the influence of temperature considerations must be taken into account. In steel the columnar structure might occur in sound metal.

Dr. Rosenhain, referring to the suggestion that in the casting of non-ferrous ingots much might be gained by a study of steel making practice, said that it was the other way about; the steel maker was looking to the manufacturer of non-ferrous metals for guidance. Steel ingots were much larger and the scale effect therefore greater. It was a pity the author had not used an ingot of circular form instead of a flat strip. The effect of using two alloys had been to increase interest in the results of the work, but it would be a valuable addition to knowledge of the subject if, instead of employing alloys of similar characteristics, the author would, in any subsequent work, make use of a whole range of alloys not of similar but of dissimilar character. His own interpretation of the results was that there was an intermediate alloy which occupied about 50 per cent. of the cross section of the ingot produced. Mr. Genders had done excellent service by introducing a new method of studying the solidification of ingots, and had made all workers in that field realise that solidification was a complicated process involving questions of temperature, turbulence, and other factors.

Dr. H. W. Brownsdon asked whether information on the macrostructure of ingots produced by the axial method of casting was available. It was clear that Mr. Genders was seeking to obtain the desired result by controlling the method of casting, and apparently was endeavouring to obtain the columnar crystal formation, but it was necessary to make a clear distinction between that type of structure and one which included both columnar and equiaxed crystals. Recent work in Germany suggested that a columnar structure might be a source of weakness.

Dr. R. S. Hutton pointed out that the work which had engaged the attention of Mr. Genders opened up a very wide field. He hoped that physicists would be induced to co-operate with metallurgists in solving the important problems involved.

Mr. J. F. Kayser thought that crystal arrangement depended on the direction of freezing; if that was unidirectional the columnar structure was produced; if freezing occurred in different directions equiaxed crystals were formed.

Mr. Genders, in his reply, said that before theories were put forward careful consideration must be given to the method by which the ingot had been built up. The columnar crystal was not harmful in itself, but only if in the formation a cavity was left down the centre of the crystal. The cavity could, however, be eliminated so that the weakness disappeared.

The next paper considered was one by Mr. W. L. Kent on "The Brittle Ranges of Bronze."

THE BRITTLE RANGES OF BRONZE.

The brittle ranges of cast and annealed bronzes containing up to 25 per cent. of tin were investigated, using the Izod impact test in the manner employed by Bunting,* and the results correlated with the known facts concerning the workability of the alloys. It was shown that alloys in the α range were brittle at high temperatures, whilst those containing the α + δ eutectoid, which are hard and brittle at ordinary temperatures, become softer and tougher above 520 deg. Cent. owing to the formation of β, which takes place at that temperature. The maximum toughness occurred in the neighbourhood of 600 deg. Cent.—an observation which is in agreement with the results of different tests performed by other workers. The effect of annealing was to bring the alloys nearer to equilibrium so that the extent of the brittle range at ordinary temperatures was diminished.

Professor Thomas Turner said that the contribution was a valuable preliminary survey of a field in which a great deal of work remained to be done. The experiments had been carried out with great care.

Dr. R. H. Greaves referred to the results of some work which had not yet been published, and which showed how the impact figure varied with temperature, the range being from about 7 foot-pounds to 40 foot-pounds. It was also noted that the alpha constituent was never associated with a high impact value.

The last paper taken on Wednesday, 10th inst., was by Dr. D. Stockdale, on "The Copper-rich Aluminium copper-tin Alloys."

ALUMINIUM-COPPER-TIN ALLOYS.

In this paper the effect of tin up to 9 per cent. by weight on the structure of the yellow aluminium-copper alloys is discussed. A remarkable feature of these ternary alloys is the manner in which the two binary systems merge into each other; there is no abrupt change in a series of solid solutions and the difference between the structure of a β bronze and a β aluminium-copper solid solution, for example, is small. The line on the ternary diagram marking the limit of the α solid solution is nearly straight at high temperatures. At ordinary temperatures, however, it is slightly curved, because when the two added elements are present in about equal proportions the temperature of the eutectoid transformation is raised about 100 deg. Cent. In a certain small number of these alloys the eutectoid transformation does not take place, but near 600 deg. Cent. the ordinary β solid solution changes over to a second solid solution indistinguishable microscopically from the first. A proportion of the solid solution poor in copper may dissolve in this new constituent, and, on further cooling, the copper-rich α phase separates out, but the mother constituent persists down to the ordinary temperature. It is for this reason and also because tin has a retarding influence on the ordinary eutectoid transformation in the aluminium-copper alloys that there are grounds for hoping that a ternary alloy for practical use may be found which will possess the advantages, with none of the disadvantages, of "aluminium-bronze."

Dr. Marie Gayler said that to investigate the effect of the addition of tin in a complicated system of the kind described in the paper had involved not only a large amount of work but required courage and enthusiasm. It was not possible, however, to be quite certain that Mr. Stockdale's interpretation of the many facts he had collected was accurate. The effect on the eutectic of the addition of a third element to a binary alloy was very far reaching.

Dr. Hanson said that the author had experienced the difficulty which had confronted others who had investigated ternary alloy systems of discovering what it all meant when the work had been done. If it was desired to apply the law of physical chemistry to alloys it must be done properly, or it was not worth doing at all.

Dr. R. H. Greaves referred to some work on the same lines which had led to some fairly definite conclusions. It was thought that some of the alloys with which experiments were made would prove superior to gun-metal, but actually they were inferior to that well-known alloy. It was now suggested that an alloy with 8 to 9 per cent. of aluminium and 5 per cent. of tin might make a good engineering material. His own experience suggested that 1 to 2 per cent. of tin was a preferable content, as the alloys were inclined to become tender at high temperatures. That was not the case with the aluminium bronzes and those containing nickel or manganese in combination with copper. He had found no indication in the tin copper alloys of the advantage of hardening by low temperature treatment, and Mr. Stockdale's work pointed in the same direction.

Mr. Stockdale said, in reply to the criticism which had been made, that his diagrams were only intended to show facts, and any doubtful results had been omitted.

The first paper taken at the morning session on Thursday, the 11th inst., was by Dr. T. B. Crow, on "Some Experiments on the Soft Soldering of Copper."

THE SOFT SOLDERING OF COPPER.

The paper deals principally with the interfacial effects which arise between soft solder and copper when the latter is soldered under conditions which do not represent industrial practice, the author's contention being that the effects observed and recorded in a series of photo-micrographs are simply "enlargements" of those which would occur under industrial conditions, and that his method of experimenting is a convenient device for studying effects which may be ultra-microscopic under ordinary soldering conditions. The wide scope of the subject is indicated and suggestions and criticism upon the many theoretical issues which it involves, and the difficulties attending a full investigation of the mechanism of soft soldering generally (as brought to light in this paper, from work upon the soldering of copper) are invited. The photo-micrographs show evidence of having been prepared with great care and should be of value in that they represent something new in this direction; the interfacial effects are most strikingly shown—a region which in many existing photo-micrographs is little more than an out-of-focus blur. A number of experiments upon matters which arose from a study of the microstructure, viz., (1) the solution of the copper by the "solder," (2) the effect of pressure (applied during joining) upon the structure and mechanical properties, (3) the identification of the interfacial alloys, is described. The results of the experiments and of certain suppositions are summarised in a general theoretical *résumé* at the end of the paper. References to relevant publications (including one of the author's, of which the present paper forms a continuation) are given.

Sir John Dewrance referred to the composition of the solders, a branch of the subject which was not dealt with in the paper. A Committee of the British Engineering Standards Association had recently fixed standards for the different mixtures to be used for particular purposes, and specifications were now on sale.

Professor Thomas Turner drew attention to the importance of a suitable thickness of solder joints. In many cases the joint was regarded as the weakest part of the structure, and it was a disadvantage to have too much solder. The standardisation of solders was an important and necessary step.

The next paper was one presented by Messrs. A. Glynne Lobley and Douglas Jepson, on "The Influence of Gases at High Temperatures, Part I."

INFLUENCE OF GASES AT HIGH TEMPERATURES.

The paper describes briefly a special type of electric resistance furnace in which the resistor is a plain carbon tube mounted vertically in water-cooled electrodes. The furnace can be evacuated, or filled with any desired gas, and an arrangement is provided by which a crucible containing the metal under treatment can be lowered from the heating zone into a water-cooled compartment, thus giving a very rapid and reproducible rate of cooling. Electrolytic copper was heated in atmospheres of nitrogen, hydrogen, and carbon monoxide respectively to various temperatures between its melting point, 1084 deg. Cent., and its boiling point, 2310 deg. Cent., being kept at the given temperature for a period of thirty minutes. The metal was then cooled rapidly in the manner stated, and examined for blow-hole volume, hardness, and macrostructure. It was shown that nitrogen and carbon monoxide are not absorbed by molten copper up to temperatures of 1900 deg. Cent. and 1700 deg. Cent. respectively, in excess of that soluble in the solid metal. Hydrogen, on the other hand, is absorbed to a varying degree at all temperatures up to approximately 2200 deg. Cent., and the excess over that soluble in solid copper is ejected on solidification forming blow-holes. The amount of gas thus held appears to bear a definite relation to the solubility of the gas at the temperature under consideration. The blow-hole volume/temperature curve falls from the melting point to a minimum at approximately 1350 deg. Cent., rising to a maximum at 1750 deg. Cent., then falling as the temperature rises to approximately 2200 deg. Cent. The macrostructure showed certain changes in the grain size regarding which further investigation is required. The Brinell numbers were found not to vary beyond the limits of experimental error from an average value of 55 with either temperature or the nature of the gas to which the metal was subjected.

Dr. D. Hanson commended the work described as a creditable attempt to obtain information of practical importance in a short space of time. He was glad to learn that the work was being continued. In ordinary works practice it was very difficult to obtain sound copper unless a certain amount of oxygen was present, and it would add to the value of the paper if the oxygen content of the copper could be given. One good method of checking the soundness of copper was to measure the density. He hoped that in future work the authors would make an investigation of the solubility of SO_2 and its effect on copper.

Sir Gerard Muntz congratulated the authors on the ingenuity displayed in the design of the apparatus used. The problem which they were attacking was one which had confronted manufacturers from time immemorial. The paper contained facts which the ordinary manufacturer could not arrive at with the apparatus at his disposal. As to the temperature at which the material should be cast, his own experience indicated that the correct temperature was between 1300 deg. and 1350 deg. Cent. If a lower casting temperature was employed air remained in the material and produced effects both of a physical and chemical character. If the copper was too hot additional gases, especially hydrogen, had to be dealt with. One of the precautions to observe when casting copper in large quantities if the temperature was over 1400 deg. Cent. was to let it rest before pouring and give time for the gases to escape. It must be kept in mind, however, in looking at the results described in the paper, that in experimental work the gases are used artificially and the conditions must not be confused with those of ordinary practice. The absence of gas bubbles could not be accepted as proof that no gases had been absorbed. Gas could get into copper in the form of oxide and might have an extraordinary effect on the properties of the material. Generally speaking, he was much impressed with the paper, and was glad to find that pure scientists were interesting themselves in what was an important manufacturing problem. He hoped that with the continuance of the research it would be possible to achieve results of real value to the copper branch of the non-ferrous metals trades.

Dr. Rosenhain said that work had been carried out at the National Physical Laboratory on the inclusion of gases in metals. It had been shown that the effects of nitrogen in copper, tallied with the results of researches on other metals, including aluminium alloys. The metals in the investigation at the National Physical Laboratory had not only been melted in an atmosphere of gas, but gas had been blown through the molten material. Some of the fears of manufacturers regarding the effects of gases on copper were baseless. Provided the gas content did not lower the density of the material, the effect of gas inclusions on the physical properties was not, it was thought, very great. An important question in connection with gases in metals was the rate of cooling, and he would like to know what it was in the case of the author's experiments. It was obviously rapid, for the reason, no doubt, that it was desired to watch the evolution of gases under definite conditions; but results of even more practical importance would be gained by slower cooling. An intermediate rate of cooling seemed to suppress the gases and hold them in the metal. The practical fact which emerged from the work described in the paper was that when melting copper it was possible to shunt the hydrogen, which was the great enemy in many metals. There could be no stronger plea than that for the electric melting process.

Mr. Lobley, in a short reply to the discussion, said that it was intended to deal with some of the points which had been raised, particularly with regard to the oxygen present in copper. In the experiments with nitrogen the surface of the metal was remarkably clear, much brighter than when experimenting with hydrogen and CO. One of the gases with which tests would be carried out was SO_2, but the work in that connection would be rather more difficult than the earlier experiments. They were glad to have had a statement from Sir Gerard Muntz on the practical temperature of pouring. As to the effects of CO and nitrogen, it was thought those gases could be absorbed by the metal without much effect on the density. The question of the rate of cooling had worried them a good deal, but it was hoped by a modification of the apparatus that it would be possible to measure the rate. The reason for the rapid cooling adopted was to get sound ingots and to catch as much gas as possible. Moreover, it was deemed essential to have conditions which could be reproduced and with slow cooling that would be more difficult. It had been suggested that the metal could be cooled in the crucible, but that involved the risk of a bridging over defect and shrinkage cavities. In furnace cooling bridging over might take place under some conditions. Specimens which were only slightly above melting point solidified within a few seconds of being plunged into the cooling tank, and those specimens near the boiling point took from thirty seconds to one minute to solidify.

* Bunting, J., Inst. Metals, 1924, 31, 47; *ibid.*, 1925, 33, 97.

Powdered Coal Plant at Dover.

WE recently had an opportunity of inspecting at work one of the boilers at the Corporation Electricity Works of Dover, which has been equipped for burning powdered coal, and in view of the fact that its arrangement is so

FIG. 1—GENERAL VIEW OF PLANT

wholly different from the enormous "cathedral-like"—to use Mr. Patchell's words—fire-boxes which have come into vogue in America for the burning of powdered fuel, we give below some account of the plant and its performance.

The boiler—Fig. 1—in question is of the Vickers-Spearing type and has a nominal capacity of 30,000 lb. of steam per hour. It is equipped with a superheater and a superimposed Green's economiser. The local conditions are such that deep excavation was not practicable, and it was therefore decided to equip the boiler with the system of powdered coal firing which has been developed by Lindley Duffield and Co., Ltd., of 199, Piccadilly, W. 1, the outstanding feature of which is the comparatively small headroom required below the tubes of the boiler. In the Duffield system of firing there is a separate pulverising unit for each furnace, but the furnace itself is really the most interesting part of the plant, and we will describe it first, going back subsequently to deal with the passage of the coal through the apparatus.

On reference to Fig. 2 it will be seen that in the place of the usual furnace with a grate there are built two pot-like structures, slightly oval in plan, with wide openings at the top and completely closed below. These pots are called by the makers "gasifiers" and are built of Leolite bricks, which, we understand, are capable of withstanding a temperature of 1850 deg. Cent. Such bricks are certainly expensive, but the number required for building a gasifier is very much smaller than the number needed for the normal type of powdered coal fire-box, and it is said that in the case of such a boiler as that under review the annual expenditure for bricks is a matter of only £45 or £50.

It might be thought at first sight that any attempt to burn powdered coal in such a confined space as that indicated in the drawing would inevitably result in failure, on account of the intense heat of the impinging flame destroying brickwork even as resistant as that employed. The fire is, however, used in a most ingenious way to provide itself for the protection of the brickwork.

All coal contains, of course, a certain proportion of ash which will fuse to form a slag, and in the case of the Kent coal which is being burned at Dover the amount is rather high. It is this slag which is deliberately deposited on the brickwork to form a constantly renewed protective lining. It is, however, essential for the success of such a scheme that the bricks shall be of such a nature that they will not be dissolved by the hot slag, and the Leolite bricks possess that characteristic to a marked degree.

It will be noticed in the plan view of Fig. 2 that the fuel is injected tangentially into the furnace, and it consequently sweeps round in a powerful vortex. The slag is, naturally, thrown out of the flame by centrifugal force and adheres to the brickwork. It does not, however, go on building up until the interior of the gasifier is completely choked up, but after a certain thickness has been deposited the surface layer attains such a temperature that it remains viscid and gradually flows down, under the influence of gravity, into the ash hopper below. The slag which is collected in this way is, however, totally unlike that produced by ordinary firing methods and more closely resembles pumice stone. From the nature of things we thought it probable that some unburned fuel might get imprisoned in this layer of molten slag and would go to waste in the ashpit, but an inspection of the ash heap disclosed very little visible carbon, and we were assured that it did not amount to 1 per cent. A very good impression of the interior appearance of the gasifier is given by Fig. 4.

It is noteworthy that it only takes a few hours for the protective lining to be built up when starting a new gasifier, and thenceforward it is maintained automatically. There is only one part where the bricks do not benefit by the protection, and there it is of not great account, as the temperature is not excessive. This spot is just about where the combustion of the coal starts, and as a consequence the ash has not been melted. The bricks themselves are, however, capable of withstanding the local temperature.

The combustion process, also, is rather novel in the field of powdered fuel. On account of the whirling action produced by the tangential inlet the larger particles of coal are forced towards the outside and consequently are maintained in circulation round the gasifier for a longer period than the fine stuff, which tends to move towards the centre of the vortex and escapes upwards readily. As soon, however, as the large particles are gasified centrifugal action loses its force and the products of combustion escape over the top lip of the gasifier.

FIG. 4—INTERIOR OF GASIFIER

The powdered coal is, of course, carried into the furnaces by a current of air, but the amount of air used for this purpose is not sufficient for its combustion, and secondary air is supplied by a special fan. Some of this air is delivered round about the coal inlet jet, while the remainder is admitted into the ash hopper. By adjusting the relative amount of these two supplies the height of the flame in the combustion chamber can be regulated. In the case of the Dover plant the secondary air is supplied by fans

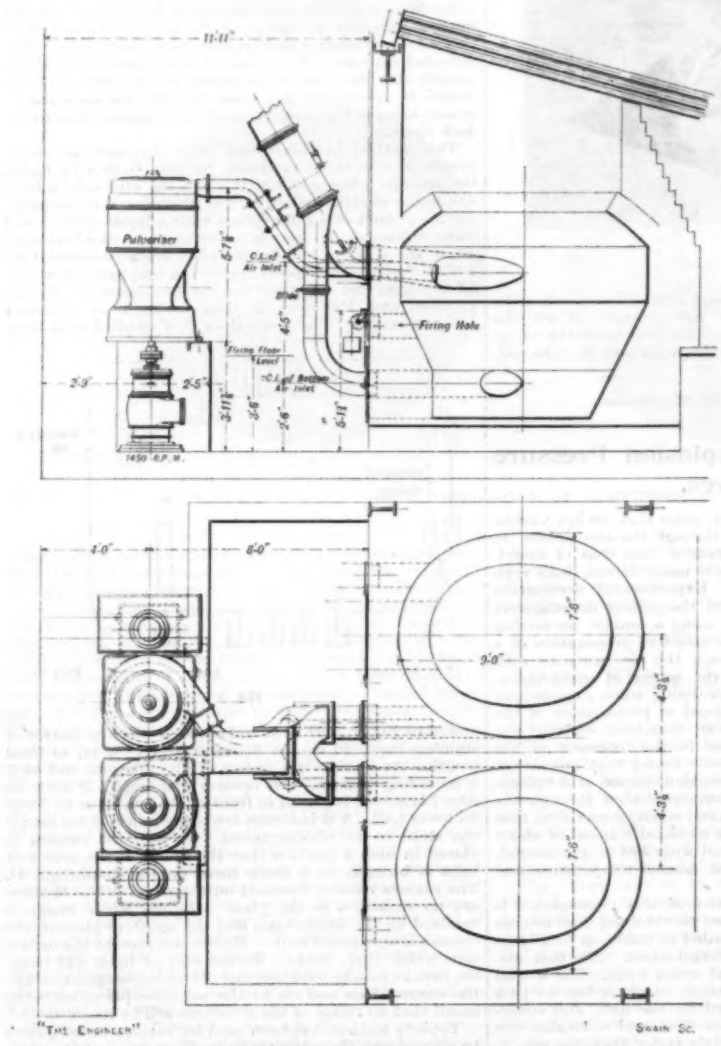

FIG. 2—ARRANGEMENT OF PULVERISERS AND GASIFIERS

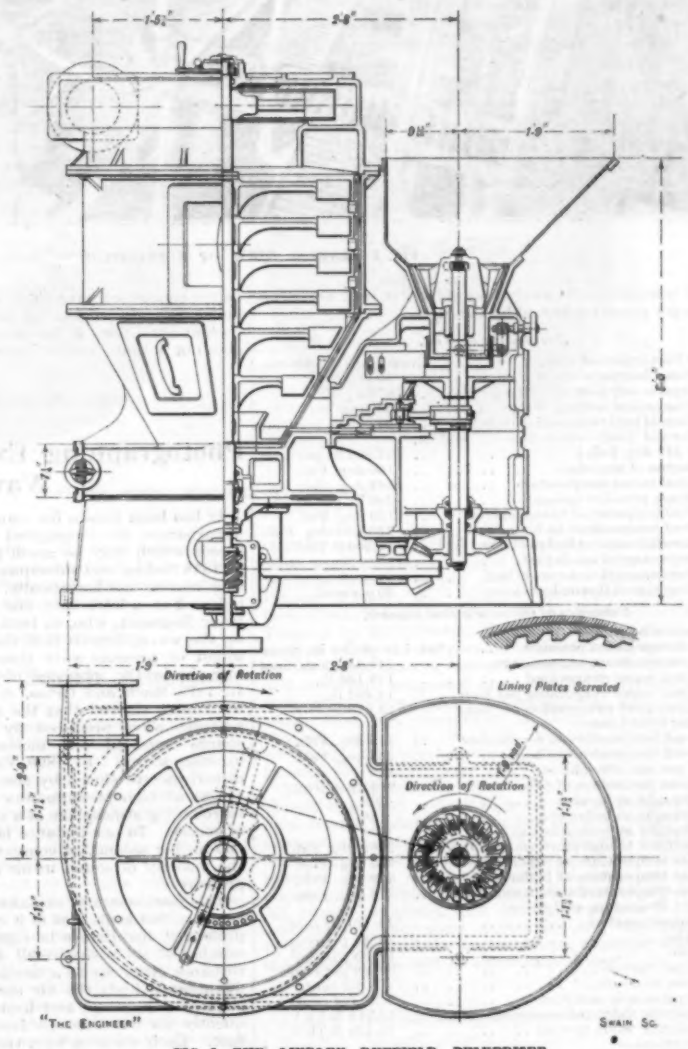

FIG. 3—THE LINDLEY DUFFIELD PULVERISER

placed on an overhead platform—as will be seen in Fig. 1—but in the most recent design the fan is incorporated in the pulveriser and the motor for driving the whole unit is arranged above instead of below floor level.

The pulveriser, of which we give a sectional drawing in Fig. 3, is of the rotary type and is characterised by the fact that it is of the impact type. That is to say, the coal is not ground, but is thrown violently against the casing so that it is smashed up by its impact. As will be seen in Fig. 2, there is a preliminary conical crusher at the bottom of the inlet hopper to reduce the coal to a reasonable size, after which it drops on to a stepped pusher plate, worked by an excentric, which feeds it forward into the pulveriser. The pulveriser comprises a series of arms on a vertical spindle rotating at about 1450 revolutions per minute, which have a clearance of about an inch from the casing. The casing is lined with deeply serrated plates, against which the coal is thrown by the beaters. On the top of the spindle there is a fan which induces a current of air through the pulveriser from an opening at the bottom. The result of this arrangement is that, so soon as the coal is reduced to such a fineness that it is buoyant in the draught of air, it is sucked away from the beaters and is carried forward, while the heavier stuff remains behind for further disintegration. The beaters, in consequence, are not burdened with the work of regrinding the coal nected together with trunking in such a manner that either or both pulverisers can supply either or both gasifiers. The coal, which comes largely from the Tilmanstone pit, is crushed in a roll crusher in the yard and is wheeled into the boiler-house to be shovelled into the hoppers of the pulverisers. This scheme is, however, obviously a temporary expedient, as it would be easy to arrange a conveying system to feed the coal continuously into the pulverisers.

The Spearing boiler has a separate smoke stack to itself, which is equipped with the Pratt system of induced draught and it was noticeable on the occasion of our visit that it was emitting no real smoke, although there was a certain cloudiness in the escaping gases on account of the grit being carried away, as the dust catcher has not yet been installed. It would seem to us, however, that when that apparatus is at work the chimney will cause no nuisance, a matter of considerable importance as the plant is situated among residential quarters in a natural hollow.

As regards the efficiency of combustion attained by this plant, it may perhaps be best to quote, in the accompanying table, particulars of an eight hours' test carried out quite recently by the contractors for the boiler.

Satisfactory as are these results, we learned from Mr. R. C. Harper, the chief electrical engineer, and his assistant, Mr. Grieff, to whom we are indebted for much of the information contained in the foregoing article, that even

FIG. 5—GENERAL VIEW OF PULVERISERS

which is already sufficiently fine, neither is their action on the larger pieces cushioned by the fines.

Particulars of Test.

Particulars of unit.	Gurarantee conditions.
Boiler heating surface	5060 sq. ft.
Superheater heating surface	870 sq. ft.
Economiser heating surface	3000 sq. ft.
Normal load evaporation (actual)	30,000 lb. per hour
Normal load evaporation (F and A, 212 deg. Fah.)	37,000 lb. per hour
Degree of superheat	160 deg. Fah.
Final steam temperature	548 deg. Fah.
*Steam pressure (gauge)	200 lb. per sq. in.
Feed temperature to economiser	120 deg. Fah.
Feed temperature to boiler	240–260 deg. Fah.
Calorific value of fuel per pound	11,500 B.Th.U.
Percentage of ash in fuel	15 to 20 per cent.
Percentage of moisture in fuel	5 per cent.
Guaranteed thermal efficiency	80 per cent.

Summary of Observer's Test Figures.

Steam conditions—	
Average steam pressure	161·1 lb. per sq. in. gauge
Average steam temperature	547 deg. Fah. final
Total water evaporated	119,100 lb.
Total water evaporated per hour	14,887 lb.
Equivalent evaporation per hour	18,610 lb.
Water conditions—	
Feed temperature to economiser	113 deg. Fah.
Feed temperature to boiler	255 deg. Fah.
Air, gas and draught—	
Mean percentage of CO_2	9·83 per cent.
Draught at furnace	·109
Draught at boiler exit	·186
Draught at economiser exit	·208
Furnace temperature (max. observed)	2462 deg. Fah.
Gas temperature at superheater	932 deg. Fah.
Gas temperature at boiler exit	429 deg. Fah.
Gas temperature at economiser exit	318 deg. Fah.
Fuel: Proximate analysis—	
Volatile matter	20·79 per cent.
Coke	75·84 per cent.
Ash	15·38 per cent.
Fixed carbon	60·46 per cent.
Free moisture	·78 per cent.
Hygroscopic moisture	2·59 per cent.
Calorific value (as received)	12,314 B.Th.U.
Calorific value (lower)	11,450 B.Th.U.
Deductions—	
Calorific value (lower) per pound	11,450 B.Th.U.
Evaporative power of fuel	11·82 lb.
Then thermal efficiency	9·81/11·82 × 100 = 83 per cent. thermal efficiency.

* NOTE.—Steam is required for the present at 160 lb. pressure only.

In the case of the Dover plant there are two pulverisers—see Fig. 5. They are arranged side by side and con- better conditions have since been attained, and when the boiler can be worked at its full pressure—which the present condition of the remaining boilers of the range does not permit—still higher efficiencies may be expected.

Photographing Explosion Pressure Waves.

IT has been known for many years that abrupt violent disturbances are propagated through the atmosphere at speeds which may be much greater than that of sound. In 1848 Stokes, and subsequently many others, dealt with this matter mathematically. Experimental verification followed at a later date, one of the earliest investigators being Regnault, who, in 1864, using a cannon for setting up the wave, showed that the speed of propagation of a sound or pressure wave through the air increases with increase in the intensity of the source of disturbance. In 1879 Mach and Gruss, continuing some experiments by Töpler, showed that the speed of propagation of the pressure wave produced by an impulsive electric discharge increased with increase in the intensity of the exciting source. In 1899 Vieille found that an abrupt disturbance produced by the sudden release of a volume of gas at high pressure was communicated through the surrounding atmosphere at a speed much greater than that of sound. In one instance he recorded a speed of about 600 m. per second, as compared with 330 m. per second, the velocity of sound in air at normal temperature and pressure.

The mathematical explanation of this phenomenon is complex, but some idea of it can be obtained if an intense prolonged disturbance be regarded as made up of a large number of successive small disturbances. The first disturbance gives rise to a normal sound wave. The second disturbance finds the air through which it has to pass slightly compressed and heated by the first, and consequently its wave travels faster than and overtakes the first. Each wave in turn travels faster than the one in front of it, and the primary wave front, continually reinforced by the arrival of succeeding waves, steepens and acquires an abnormal amount of energy. With the increase in energy the speed of the wave front rises above the normal speed of sound, the maximum speed attainable being that of sound in air at the temperature prevailing immediately behind the wave front. This form of wave front gives rise to a rapid and large change of pressure in the medium through which it passes, and is called a shock wave.

This explanation of the genesis of a shock wave is taken from Paper No. 18 of the Safety in Mines Research Board, recently published by H.M. Stationery Office, price 2s. net. This paper forms Part I. of an account of an investigation by Messrs. W. Payman and H. Robinson into the pressure wave sent out by an explosive. The object of the research was to secure photographic records of the shape and appearance of pressure waves, and of their speed of propagation. For this purpose special optical and electrical timing devices are being used.

Two difficulties stand in the way of photographing the pressure wave sent out by an explosive. The wave in the first place, is invisible, and, in the second, its speed is too great to permit ordinary methods of taking "instantaneous" photographs to be used.

Two distinct methods of observing atmospheric strie have been employed by previous investigators, namely, the "shadow" method of Dvorak and the "schlieren-methode" of Töpler. Both depend upon the refraction which takes place when light passes from one medium into another of different density.

In the Dvorak shadow method the strie to be observed

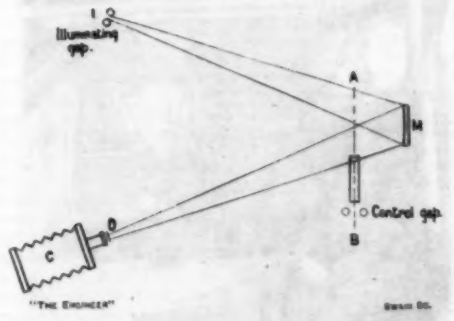

FIG. 1

are produced in the atmosphere between a point source of light and a screen or photographic plate. If the striations be supposed replaced by a gaseous sphere of density different from that of the surrounding atmosphere, it will be understood that rays of light passing through the edge of the sphere will be deflected to some short distance away from the points on the screen or plate, which they would strike were the sphere absent. On the other hand, rays striking the sphere almost normal to its surface will pass through it with little or no refraction, and will suffer a relatively small amount of displacement on the screen. In effect a shadow of the edge of the sphere is thrown on the screen and appears as a black circle. The deflected rays serve to increase the illumination inside or outside the black circle, according as the density of the sphere is greater or less than that of the surrounding atmosphere, and cause a bright circle to appear close to the dark circle.

This method has been used to photograph the atmospheric disturbances produced by rifle bullets in flight, the pressure pulse sent out through the atmosphere by a disruptive electric discharge, the phenomena accompanying the impact of a solid sphere with a liquid surface and other subjects. It has, however, certain disadvantages when the strie to be photographed are accompanied by actinic flame. The Töpler method is free from these disadvantages, and was used for the most part by Messrs. Payman and Robinson in their research on explosive pressure waves. The method as they applied it is illus-

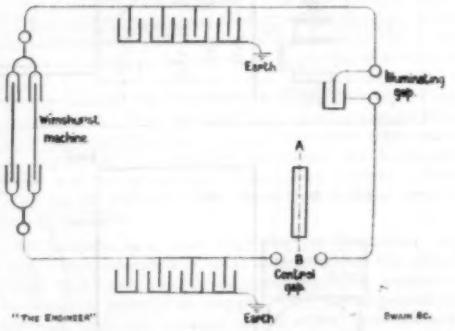

FIG. 2

trated in Fig. 1. At M is indicated a concave mirror of stainless steel, 46 cm. in diameter and 1·83 m. in focal length. At 1 there is a source of illumination, and at C a recording camera. An opaque diaphragm D with its edge horizontal is placed in front of the lens so as to cover its lower half. A B indicates the plane in which are set up the strie to be photographed. In use, the camera is placed in such a position that the image of the source of light is brought to a sharp focus on the diaphragm D. The camera itself is focussed on the plane A B. If there are no striations in the plane A B, the whole image is received on the diaphragm, and the sensitive plate in the camera is unexposed to it. If strie are present the deflection which they produce in the rays of light will cause the rays to pass beyond the edge of the diaphragm, through the camera lens and on to the sensitive plate, with the result that an image of the striations will be received.

Töpler's method has been used by various investigators to photograph the pressure pulse from an electric spark, to illustrate phenomena connected with the propagation of sound, to photograph flame phenomena, and to record the atmospheric disturbances caused by high-velocity projectiles in flight.

Either of these methods serving to make explosion pressure waves visible, the next point to consider is the difficulty introduced by the high speed of the waves. When photographing a moving object, the plate must be

exposed only for a period during which the movement of the object is inappreciable. If the object is moving with the speed of sound, 330 m. per second, its displacement in one hundred thousandth of a second is 3¼ mm., so that with a 4 to 1 reduction the image on the plate will move during the exposure period about ¾ mm., an amount sufficient to produce excessive blurring. A shock wave may move at many times the speed of sound. To use a mechanical shutter for the purpose of obtaining the necessary short exposure is out of the question, and as an alternative the plan is generally adopted of maintaining the illumination for no more than the exposure period required. To this end, Messrs. Payman and Robinson used the spark produced by the discharge of a Leyden jar. Such a spark, it is believed, has a duration of about one ten-millionth of a second, and, in addition, has an actinic effect quite sufficient to act on a sensitive plate exposed to it for this short period. The plates used were of the "process" variety of a low speed—H. and D. 20.

A body moving with the speed of sound would traverse the field of view of the camera in Fig. 1 in less than one two-thousandth of a second. The synchronisation of the illuminating spark with the appearance in the field of view of a rapidly moving shock wave calls therefore for the employment of delicate means. Recourse was had to electrical methods. In bullet photography it is usual to cause the bullet itself to effect the timing by making it short circuit a spark gap, the "control gap," in such a way that an illuminating spark is produced simultaneously at a second gap, the "illuminating gap," arranged in series with the first. Such a use of the projectile was impossible in Messrs. Payman and Robinson's experiments, but an adaptation of it proved quite successful. This adaptation involved a control and an illuminating gap, the control gap being closed electrically by a copper strip when such strip was hit by the wave to be photographed. This method gave accurate control when the source of disturbance was provided by the bursting of a diaphragm.

When the disturbance was created by an explosive, it was found possible to employ a still simpler method of effecting the synchronisation. It was discovered that the gaseous products of the detonation, either by virtue of their temperature or composition, or both, were capable of causing the breakdown of an electrically charged spark gap, and so could be made to time the passage of the illuminating spark. The arrangement employed is illustrated in Fig. 2. A motor-driven two-plate Wimshurst machine was used to charge two batteries of Leyden jars. The outer vessels of the jars were earthed and the inner were connected across two spark gaps in series, one of which, the illuminating gap, had a small Leyden jar connected in parallel with it to increase its luminosity. The control gap was placed in the line of fire of the explosion. To prevent the control gap appearing in the photograph, the arrangement was subsequently modified to the extent of dividing the wave into two separate portions, one being used to break down the control gap, set out of the field of view, while the other was photographed. The spark gaps consisted of two brass spheres, 5 mm. in diameter, the illuminating gap having a fixed width of 1 cm. and the control gap a width varying from 2 cm. to 5 cm., according to atmospheric conditions.

A method of measuring the speed of the wave was developed. It was found that with a particular setting of the diaphragm in front of the camera lens the wave front appeared in the photograph as an intense black line, and without anything but the outline of the wave being shown. With this setting of the diaphragm and a continuous source of illumination, a photograph was taken on a length of film stretched on a rapidly revolving drum. A continuous time-distance diagram showing the movement of the wave front was thus obtained. The film was moved vertically and in front of it a horizontal stenopaic slit was fitted. By this arrangement the outward spread of the wave was not recorded, and the position of the wave front at any instant was given by a spot of light, and the record of its movement by a clearly defined black line across the film.

With the results of the experiments carried out by means of the equipment we have described, we do not propose to deal, but will leave those interested to consult the original report. The experiments undertaken cover a study of the waves sent out through the atmosphere on the rupture of diaphragms by compressed air, on those sent out by a detonating gas mixture, and on those sent out on the explosion of a detonator.

By courtesy of the Safety in Mines Research Board, we are enabled to reproduce in Fig. 3 six of the original photographs taken by Messrs. Payman and Robinson by means of the Schlieren method. This series of photographs illustrates the propagation of combustion in a mixture containing 9·5 per cent. of methane, when fired in a brass tube, 2·5 cm. internal diameter, by means of an electric spark at the centre of the tube. In the first and second views the mixture ejected from the tube in advance of the flame is shown. The remarkably beautiful symmetry assumed by the unburnt gas in the second view is very striking. In the third and fourth views the flame following the unburnt gas is seen. In the fifth and sixth views flame alone appears to be present. These photographs were taken with a silvered glass mirror instead of with one of stainless steel. The circles seen at the centres of the photographs and the four circular dots surrounding the central circle are effects produced by strain in the mirror.

Comment on these most interesting experiments is unnecessary, and in any event, as they are not yet completed, would be undesirable. It may, however, be suggested that the methods employed seem to be capable of application in several important directions, notably perhaps in the field of aeronautical research.

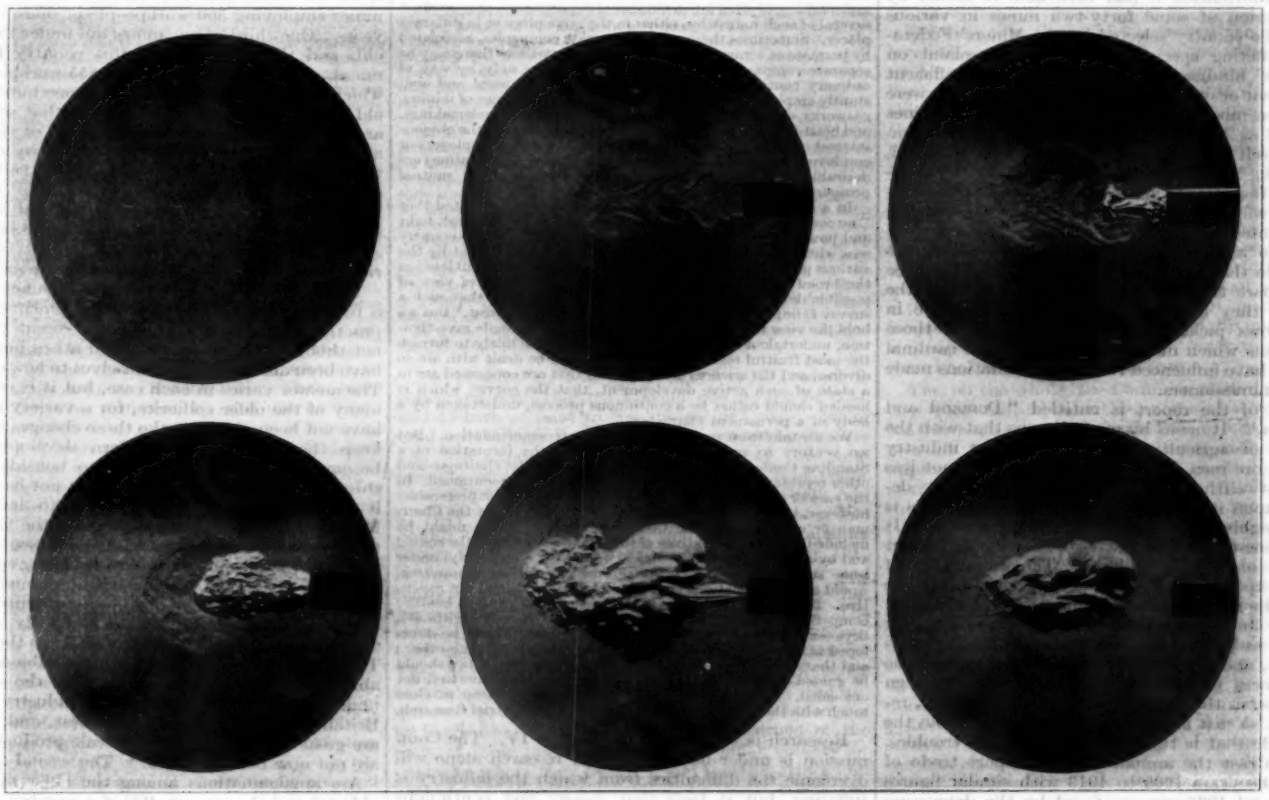

FIG. 3—PROPAGATION OF COMBUSTION IN A 9·5 PER CENT. MIXTURE OF METHANE

Motor Ships for South America.

FURTHER particulars are now available of the three motor ships to be built by William Beardmore and Co., Ltd., at the Naval Construction Works, Dalmuir, for the Companhia Nacional de Navegacao Costeira, of Rio de Janeiro. The following are the principal dimensions of the ships:—Length between perpendiculars, 370ft.; breadth, moulded, 52ft.; depth, moulded, 26ft. 9in.; mean draught, maximum, 20ft. 6in.; deadweight, about 3800 tons; speed on trial, 14¼ knots.

The vessels are to be built to Lloyd's highest class 100 A 1, with freeboard, and will have a straight stem, an elliptical stern, one funnel and two pole masts. Above the upper deck the erections will consist of poop, promenade and forecastle decks, upper promenade and boat decks. The ships are to comply with the British Board of Trade requirements with regard to subdivision, the passenger and crew accommodation, life-saving appliances, &c. The oil fuel will be carried in the double bottoms forward of the machinery space and in deep tanks in the wings abreast of the auxiliary boilers, the total oil fuel capacity being about 600 tons. Accommodation is to be provided for thirty-nine first-class passengers in thirteen state rooms on the upper deck and for one hundred and six first-class passengers in thirty-six state rooms on the promenade deck. The intermediate passengers, forty in number, are to be accommodated upon the poop deck in four and six-berth cabins. There will also be accommodation for ninety third-class passengers in nine compartments on the main deck forward. The whole of the public rooms for passengers, officers and crew are to be exceptionally large and roomy, in view of the special service in a tropical climate for which the vessels are intended. There will be two compartments on the main deck, one forward of the machinery space for provisions and one abaft the machinery space for the carriage of meat and fruit, and refrigerating machinery, fans and trunking will be provided to keep these spaces at a suitable temperature. The total cubic capacity of the refrigerated chambers will be about 20,000 cubic feet.

The vessels are to have three cargo holds forward of the machinery space and two cargo holds aft. Nos. 1, 3 and 5 cargo holds will be served by one hatch placed on the centre line of the ship, and Nos. 2 and 4 cargo holds by two side hatches each. No. 3 cargo hold is to be entirely sheathed with cross boarding for the carriage of salt. Ten hydraulic cranes are to be provided for dealing with the cargo, eight of which are to be capable of lifting 30 cwt. each and two—serving No. 2 hold—will be of 3 tons lifting capacity. In addition to these cranes an electric warping winch will be fitted aft on the poop deck and an electric boat-hoisting winch on the boat deck.

The auxiliary machinery will comprise two steam-driven compound engines and dynamos, each having an output of about 100 kilowatts at 220 volts. An emergency lighting set driven by a paraffin engine is also to be provided.

The steering gear will be of the electric-hydraulic type, and will be placed under the poop and controlled by telemotor from the navigating bridge. The windlass will be steam driven and of the direct-acting vertical type, with quick warping ends.

The main propelling machinery will consist of two six-cylinder Beardmore-Tosi single-acting four-stroke cycle engines of the same general design as those fitted by William Beardmore and Co., Ltd., to the motor ships Pinzon, Pizarro, and Silurian, and those built under licence from Messrs. Beardmore for the M.SS. Sycamore and Tramore by Richardsons, Westgarth and Co., Ltd. The engines will have incorporated in them a number of minor modifications tending towards simplicity, ease of access and overhaul, suggested from the experience obtained with the previous ships. Furthermore, they will, we learn, have the distinction of being the first supercharged motors to be built in this country. The advantages of supercharging in connection with the trade foreseen for these ships are very considerable.

The leading features of the engines having been previously described in THE ENGINEER, it is unnecessary to give further details. They will develop, when supercharged, a maximum of about 4750 indicated horse-power when running at a speed of about 140 revolutions per minute. Steam will be supplied for deck use and for engine-room purposes by two oil-fired auxiliary boilers. All pumps connected with the main engines are to be separately driven, some electrically and the remainder by steam. Most of the engine pumps, however, supplying the main engines will be electrically driven.

A FEW days ago London spoke direct to Berlin by telephone. The service started at six o'clock, and the calls had been booked up for all the evening long before. Three minutes' conversation costs 16s. to Berlin until eight o'clock, and 9s. 7d. afterwards. The line was quite good, and calls were made to Hamburg, Bremen, and Cologne, in addition to the German capital.

The Coal Commission.

IT was on September 5th, 1925, that by a Royal warrant a Commission was appointed to inquire into the whole conditions of the coal industry of the United Kingdom, and to report with as little delay as possible to his Majesty. The Commission was composed of the Right Hon. Sir Herbert Samuel (chairman), General Sir William Lawrence, Sir William Henry Beveridge and Mr. Kenneth Lee, and it had as assessors the Right Hon. William Brace, Mr. A. E. Cutforth, Dr. Walcot Gibson, Major H. M. Hudspeth and Dr. C. H. Lander, and for its secretaries Mr. C. S. Hurst and Mr. F. C. Starling.

It was essential that the work of the Commission should be done in the spring of this year, and before the coal subsidy came to an end, which it does on April 30th, so that Parliament might be in a position to decide whether or not it should be renewed for another period. The Commission threw itself into its work with vigour, and although it had to examine no less than seventy-six witnesses at thirty-three public sittings, it was able to complete its report for publication at the end of last week. That report is a volume of almost 300 pages, full not only of statistics taken from various sources, but of a great deal of shrewd comment upon the evidence placed before the Commission and of opinions and recommendations made by the Commission after duly weighing the divers views of the witnesses it had examined, and the information it had been able to secure by the inspection of some forty-two mines in various parts of the country selected by the Miners' Federation as offering special grounds for complaint on account of hindrance to output due to inefficient management or other causes. These inspections were made by members of the staff of Inspectors of Mines who acted as Assistant Commissioners, but the Commission itself visited twenty-five mines in Scotland, Lancashire, Yorkshire and South Wales. We mention these few facts to give some idea of the thoroughness with which the Commission did the work that it was appointed to do.

Valuable and instructive as the report is, it is improbable that many of our busier readers will be able to spare the time to study its pages with the care that they deserve, and we have therefore in what follows picked out from each section those observations which may be regarded as the cardinal facts that have influenced the recommendations made by the Commissioners.

Part I. of the report is entitled "Demand and Utilisation." It opens by reminding us that with the exception of agriculture, the coal-mining industry employs more men than any other, and that not less than one-twelfth of our population is directly dependent upon it, whilst the value of its products is in the neighbourhood of £250,000,000 a year. It provides one-tenth of our exports in value and about four-fifths of them in volume. The importance of this coal export trade cannot be exaggerated, and the effect of the war upon it is summarised in the report. Not until July, 1921, was the industry free to set about the task of recovering the export trade that is vital to it, and it is satisfactory to learn that in the circumstances the degree of success that has been attained is, in the opinion of the Commissioners, remarkable. Yet it is the export trade rather than the home trade that is the seat of our present troubles. If we contrast the annual average export trade of coal for the years 1900 to 1913 with similar figures for 1924 and 1925, we are faced by the depressing fact that in the year before last the loss amounted to no less than nearly 3,200,000 tons, and that last year the loss had risen to well over 15,000,000 tons. The most striking reductions are in the exports to Germany and Russia. In the case of Germany, the most important single reason for her reduced consumption of coal is undoubtedly to be found in her increased production of lignite, whilst in the case of Russia the cause is economic dislocation following the revolution. But besides the loss of our market to Germany, which in 1913 amounted to about 9,000,000 tons, Germany has done much to rob us of our market with Italy, which in the same year was nearly 9½ million tons, and is now but little over 7 millions. The loss to South American markets has been influenced considerably by the substitution of oil fuel, but, says the report, there is now, however, a reaction. The proportion of oil used by the Argentine Railways is steadily diminishing. Our loss to France is comparatively inconsiderable, less than half a million tons, but the comment of the Commissioners is illuminating: "The destruction of the mines in her northern coalfield has led to their re-equipment with modern plant and machinery, and her production is now 3 million tons a year more than in the pre-war period. She uses three times as much hydro-electricity as she did then; yet she imports 6 million tons more coal, for her consumption has increased by nearly 10 million." In France it appears our loss is due not to reduced consumption, but to competition by Germany.

The Commission reaches the general conclusion that "while Germany has gained some ground from us in France and Italy and more recently in Scandinavia, and while we have lost markets elsewhere by the impoverishment of our former customers or the use of substitute fuels, the causes of the depression in the British coal industry must be regarded in a large measure as general causes affecting almost all European coal-producing countries."

In the second chapter of its report, the Commission reviews the national coal resources and reaches the comfortable conclusion that the coal at present known to exist in the United Kingdom will last for between four and five centuries, and if account is also taken of possible reserves, not for seven hundred years will our mines be exhausted. In Chapter III. we find some interesting facts and comments upon the utilisation of coal. We need deal with it in no detail, as the subject is one which has occupied the attention of technical men almost *ad nauseam* for many years past, but we observe that the Commission was invited particularly to consider the utilisation of coal in connection with the generation of electricity, and it is necessary to quote here several important passages which may have future consequences.

It has been strongly impressed upon us as the outcome of our inquiries that it is an error to suppose that the only, or even the principal, object to be aimed at in this connection is the most economical method of producing electricity. The object to be aimed at is the most economical and efficient way of utilising the energy embodied in the coal. The question is not the co-ordination, as is often supposed, of two industries—coal and electricity; but of several—coal, electricity, gas, oil, chemical products, blast-furnaces, coke ovens, &c. Two or more methods, dealing with two, three, or more of these, may be used simultaneously in combination, one feeding the other.

The point of importance is that no obstacles, whether of State regulation or industrial organisation, should be placed in the way of the development of such combinations, in whatever manner engineering and chemical skill, and the economic conditions, may indicate as the most suitable. Sometimes a single commercial undertaking, divided into a number of departments, may conduct several of such industries, either in the same place or in different places. Sometimes there may be separate companies, associated by permanent commercial agreements. Sometimes there may be separate companies, dealing with one another only by way of ordinary contracts. It should be clearly recognised and constantly emphasised that the interests of the industries of mining, gasworks, electricity stations, coke and by-product undertakings, and blast-furnaces are closely interlocked, and it is to the obvious interest of those who are engaged in them, whether employers or employed, that they should encourage whatever combinations are desirable in each particular case to promote their mutual prosperity.

In a memorandum prepared by Dr. Lander, it is stated that "no comprehensive survey has ever been made of the heat, light and power requirements of various industries or of the country as a whole, and how they can be most economically met by the various processes at present commercially feasible; still less has the broad question been considered from the point of view of possible development in the future." We consider that such a survey is imperatively required in the national interest. But we hold the view that it is not a matter on which a single investigation, undertaken at a particular time, would be likely to furnish the most fruitful results. The problems to be dealt with are so diverse, and the sciences and practices that are concerned are in a state of such active development, that the survey which is needed should rather be a continuous process, undertaken by a body of a permanent character.

We abstain from making any definite recommendation. But we venture to suggest for consideration the formation of a Standing Conference, composed, perhaps, of the chairman and other representatives of the three bodies we have mentioned. In the case of coal, the Secretary for Mines might find it preferable, however, to choose some representative who was not the Chairman or a member of the Coal Commission. There might be included also representatives of the oil interest, and of the coking and by-products and the chemical industries. This body, under some such title as the National Fuel and Power Committee, would exercise functions that would be advisory and not executive. Its primary task would be to ensure that, while a healthy competition should be maintained, where it was legitimate, between these various interests, their energies should be developed in a manner complementary, in the main, to each other; and that the actions of the State and of local authorities should be guided by a survey which would be comprehensive and not one-sided. Such a committee would doubtless keep in close touch with the Department of Scientific and Industrial Research.

Research is the subject of Chapter IV. The Commission is under no illusion that research alone will overcome the difficulties from which the industry is suffering, but it feels that steady and continuous investigation into all pertinent problems is essential if the industry is to prosper and to provide good wages and conditions for its workers. It does not believe that these problems will ever be solved by a system of small grants to bodies or individuals, and it recommends that the British Colliery Owners' Research Association should be rapidly expanded and placed on such a footing that it can deal adequately with the problem. The managing council of the Association should be composed of representatives of the owners, managers, mining engineers, workers in the industry, the Mines Department and the Department of Scientific and Industrial Research. A director of research having high qualifications in physical, and, if possible, in engineering science, should be appointed at an early date, and a research headquarters be established. The Commission places the cost of such work at an average of about £50,000 per year, and it recommends that the funds be provided partly by the Department of Scientific and Industrial Research. "We are strongly of opinion," write the Commissioners, "that research work can only be carried on efficiently if the organisation concerned is in a position to develop its programme logically and steadily, and that nothing is so conducive to inefficiency and to wasteful expenditure as instructions to develop the work alternating with instructions to contract it. Steps should therefore be taken to ensure that the organisations concerned are in a sound financial position, so that they can develop their programmes in a methodical manner over a period of years."

The second part of the report, which is entitled "Organisation of the Industry," opens with Chapter V. In it we find a great deal of very interesting information about the British coal industry, which is not commonly known. The characteristic feature of the coal industry is its diversity, owing to geological differences, thickness of seam, chemical composition, degree of mixture with dirt and other impurities, the conditions of the mines as regards safety and water, and various other technical points. Then there are geographical differences and differences caused by variations in the working customs of the district, to say nothing of the differences due to the history or character of a particular mine. The industry cannot, therefore, be regarded as a collection of more or less uniform undertakings, employing so many men under conditions fairly similar, producing a single article, the cost of production and the price obtained varying little at any time. Hence it is only possible for a few purposes to treat the industry as a whole, and controversies that are taking place with respect to it, supported as they have been with average figures relating to all the mines, have frequently been beside the mark. In Great Britain there are now 1400 colliery undertakings, owning about 2500 mines. Many of them employ less than 50 men, several more than 3000. Some make a profit of 5s. per ton under favourable conditions, whilst some lose an equal amount even when the conditions are as favourable as they were in 1923. An obvious characteristic of all mines is that they are always obsolescent. Obsolescence and closing of mines is a normal feature of the industry, and the question arises with respect to every mine without exception at what date it ought to be closed. Every year a considerable number of new pits are opened, and over a series of years about an equal number are closed. From a table we learn that the average age of the larger mines employing 500 workpeople or more is fifty-one years. One-third of our mines are under thirty years old, and there are still in this country fifty-seven mines, employing an average of 855 workpeople each, which are known to be more than one hundred years old. We have mentioned the fact that some mines are worked by very few men. Some of these mines are no more than pockets of coal left by old undertakings, and the miners are very aptly called by the Commissioners "the gleaners of the coalfield." They are outside the purview of coal mining as a whole, and in the view of the Commissioners they should not be interfered with unless some overriding public interest is involved in particular cases.

The large majority of our existing mines date from a period when the technical developments of mining practice which have characterised recent years, were not thought of, and the question arises how far they have been able to adapt themselves to new conditions. The answer varies in each case, but it is certain that many of the older collieries, for a variety of reasons, have not been able to make those changes that would keep them abreast of modern developments. It becomes necessary, therefore, to consider whether this process of modernisation might not be facilitated if the industry were combined into larger units. Many reasons have been laid before the Commission to show that "the usual size of the present undertakings is not large enough to fit the existing conditions," and it is urged that the present economic difficulties are largely the result of small-scale production. The Commissioners have therefore carefully considered four questions, and to them they give their replies. The first question is, "Is further combination desirable?" and to it they reply "that the size of the undertakings usual in the coal industry in Great Britain is not economically the best, and that there are great advantages in large-scale production which are not now being realised." The second question is, "Are amalgamations among the older mines desirable?" and the answer, "that a number of amalgamations have, in fact, been effected in the older coalfields, and with advantage; that they are therefore clearly not impracticable; but that not in every case is amalgamation desirable; and that to compel parties, who object to it, to work together in a combined undertaking would be a mistaken policy." "Is the initiative of the industry itself sufficient?" is the third question. To it the Commissioners reply "that while in some cases fusion or absorptions which are desirable have taken place, and in other cases fusions or absorptions would be attended with a balance of disadvantage and should not take place, we cannot doubt that between these two classes there are a large number in which such amalgamations are desirable, have not yet been effected and are not likely to be effected, if the matter is left entirely to the action of the parties directly concerned." Finally, the Commissioners ask, "Are further measures desirable?" and to it they give the following reply:

(1) The fusions that are desirable must be effected with great care, and with intimate knowledge of the physical and financial considerations that are involved in each case;

(2) Any measure that fixed a general rule of size or output, and applied it uniformly without regard to the individual conditions, could only be mischievous;

(3) Amalgamations, where they are made at all, should in most cases be complete, but might sometimes be rather of the nature of the combined action of separate businesses for power supply, co-operative selling or other purposes;

(4) The necessary elasticity, and harmonious working, could best be obtained if the initiative came from within the industry itself;

(5) Where one or more undertakings in an area desired to effect an amalgamation, but others, whose co-operation was necessary, refused, or demanded unreasonable terms, there must be power in the public interest to over-ride such opposition; the action to be taken in such a case should rather be of the nature of securing the transfer of leases from the present holders to the new combination, at a valuation such as would be reasonable in the circumstances, than any attempt to make the parties

work together against their will. It is more practicable to combine mines than mineowners.

We come in Chapters VI. and VII. to two subjects around which much conflict is likely to centre, and on which violent differences of opinion already exist. The first of them is the "Nationalisation of Mines" and the second "Royalties." It may be said at once that the Commissioners are not in favour of the nationalisation of mines themselves, though they are in favour of the nationalisation of coal. The distinction must be clearly noticed. It means that whilst in the opinion of the Commission the mineral itself should belong to the State, the winning of it should be entrusted to leaseholders. We shall now briefly review the argument put forward by the Commissioners, first, with regard to nationalisation of mines, and, secondly, with regard to nationalisation of royalties.

In discussing the former, the report recalls the diversity of coal mining, and expresses the belief that in the future coal mining will become an integral part of a great industrial complex, comprising also electricity, smokeless fuel, gas, oil, chemical products, blast-furnaces, and possibly other activities. It is this feature that makes the mining industry particularly unsuitable for conduct by the State, for it involves a willingness to experiment and a readiness to take risks. The Commissioners are clearly of opinion that the variety and freedom of private enterprise are more likely to conduce the progressive development of this particular industry than control by the State. In this connection, the following important passage must be quoted in full:

> With respect to the interlocking of mining with other industries, it must be noted that the scheme which we are examining does not propose to nationalise, at this stage or for an indefinite time in the future, any part of the vast combination which is gradually being evolved, except the mines themselves and those coking plants which are situated at the collieries. But if mining were nationalised and the other associated industries remained in private hands, a new frontier would be drawn across the domain. Integrations that have already been effected would have, in fact, to be broken up. Probably not less than one-fifth of the coal production, other than for export, is already carried on by companies which conduct at the same time blast-furnaces, or coking enterprises in other localities, or other associated industries. It is proposed to sever into its component parts all this organisation, the creation of years of effort and enterprise. By removing these mines into State ownership, the very sections of the industry which already approach the standards that are likely to prevail in the future, would be the most injured. Existing combinations would be disintegrated, and a serious obstacle would be raised against further integrations.

It is estimated by the Commissioners that the cost of purchase of the coal industry would amount to something approaching £350,000,000. That large sum could only be provided by the use of State credit, and after discussing various means of financial control, the Commissioners say "we cannot find here the basis for a vast industrial undertaking. We cannot afford to rely merely upon the hope that, out of a spirit of goodwill and public responsibility, the independent bodies which will conduct the industry will fully safeguard the interests of the Treasury." On the subject of prices and wages, the Commissioners make the familiar comment that it is most probably that "the workers' representatives on the Consumers' Council would be less anxious to keep down the price of coal than, through a sense of labour solidarity, to keep up miners' wages," and on the question of purchase of uneconomic mines they observe that "the closing of uneconomic mines, always a matter of difficulty, would become far more difficult under nationalisation, for there would be a strong temptation to draw upon the profits of the better mines rather than to inflict hardship and incur resentment involved by such an operation." Finally, they point out that if the mines were owned by the State, our great export trade would have to be conducted by the State, and that international complications would be inevitable. They reach, as a whole, the following conclusions:—

> In discussing the proposal for nationalisation, we have confined ourselves to the precise problem before us, in relation to the industry of coal mining. There are many other considerations, not peculiar to coal mining, which bear upon the general question of State action in trade and industry. We have not examined those considerations here, although they are by no means irrelevant. We should certainly not have felt, however, that they would have precluded us from recommending the nationalisation of the mines if the case for it had been proved. But the burden of proof is on those who advocate nationalisation. We have felt bound not to recommend it unless we felt satisfied that there was presented a workable scheme, offering a good prospect of success and of a clear economic and social gain. We have seen, however, no scheme that will withstand criticism; we perceive grave economic dangers; and we find no advantages which cannot be attained as readily, or more readily, in other ways.
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> For the choice of policy is not limited to two alternatives, between the industry as it now is, on the one hand, and nationalisation on the other. There is another course. We recognise that there is substance in the demand which nationalisation is intended to meet—the demand for large changes in the organisation, and improvements in the efficiency, of the industry, for an expansion of the miner's influence over the conditions that govern his working life. This legitimate demand we believe can be met without embarking upon an operation so vast and so hazardous. It is one of the principal objects of this report to suggest the means.

It seems not improbable that at one time all minerals were the property of the Crown, but in the "great case of mines," in or about the year 1568 it was finally decided that only the so-called Royal Mines, those of gold and silver, belonged to the Crown, and that all the baser minerals belonged to the individual landowners. The Commissioners see no reason why this valuable commodity, the property in which was conceded long ago to the private surface owners, should now be offered as a free gift to persons who are engaged in the mining industry, whether as mineowners or as miners, but they concur in the general conclusion that the system of private ownership of this great natural resource is open to grave objections, and they hold that it would have been very fortunate for the country if three and a-half centuries ago the legislature had reserved the coal to the State. "The present generation should not be deterred by the difficulties that attach to the problem from undertaking to redeem the error of the past. Among the miners in particular there is resentment at a charge being levied upon the fruits of their labour for the advantage of individuals, in return for which in their capacity as owners neither work nor enterprise has usually been given on their part. It is unlikely that there will be lasting peace in the industry so long as this grievance continues without redress." The Commissioners therefore recommend that a simple scheme of purchase of both developed and undeveloped coal should be instituted, and they accept the figure of £100,000,000 as the probable reasonable purchase price of the royalties. When they come to the examination of the Government's balance sheet on the transaction, they are brought to the conclusion that "there might be a profit of a comparatively small sum or there might be a small loss, but the factor is not one of large importance."

If this scheme be put into operation, a number of points consequential upon the proposals will have to be considered. Of these points, we need lay stress on three only. They are as follows:—

> (1) It will be necessary to establish an authority which will act on behalf of the State in acquiring and administering the valuable property which will come into national ownership. We propose that a body, to be entitled the Coal Commissioners, should be appointed, in whom would be vested the ownership and the administration of this property. The Coal Commissioners would be nominated by the Secretary for Mines and responsible to him.
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> (2) We do not contemplate that the Commissioners should intervene in any way in the working of the mines, except so far as may be necessary to assure themselves that the conditions in any lease granted by them are not being infringed; nor that they should take any part in the settlement of labour disputes. To impose upon them that task would probably impair their effectiveness in the performance of their essential duties.
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> (3) It would be one of the duties of the Commissioners to seek for coal and to prove new coalfields. A proposal on similar lines has already been the subject of a recommendation by the Geological Sub-Committee of the Coal Conservation Committee of 1918. Whatever legal powers might be needed to facilitate the fulfilment of this duty should be conferred.
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> It would be open to the Commissioners to consider whether they should enlist private enterprise in the work.

We propose to skip over Chapter VIII., which is concerned with the distribution and selling of coal, and to turn at once to the subject of Conveyance of Coal and Railway Rates, which are covered by Chapter IX. It appears from the report that the total receipts of the railway companies from coal traffic were £22,600,000 odd in 1913 and £37,700,000 odd in 1924—an increase of 67 per cent. Evidence laid before the Commission by the railway companies shows that the increase of railway rates over 1913 is due entirely to the increased cost of labour and material, and railway expenditure generally has increased in the same period by 120 per cent. The railway transport of coal is kept high by four factors, first, the rate of railway wages and the conditions of work of railway employees; secondly, the small size of the trucks usually employed; thirdly, the requirements that all trucks other than those belonging to the railway companies should be returned at the ends of their journeys to the particular colliery or trader to whom they belong; and fourthly, the small number of journeys travelled by each truck per month. The first cause is not discussed by the Commission, but to the second it devotes much attention, and the whole subject of large wagons is very carefully discussed. On the four points mentioned, the Commissioners make the following recommendations:—The measures that they suggest are such that the economy to be effected in railway operating by pooling of wagons and by use of larger wagons would accrue in the greater part to the benefit of wagon owners. They hold that the principle adopted by the Great Western Railway in allowing a 5 per cent. rebate on the rates for all coals carried in 20-ton wagons should be accepted as the first step in a general policy. Their recommendations are these:—

> 1. The general saving in railway operating that may be expected in the several districts, if 20-ton wagons were substituted for those now in use, should be estimated. The railway companies should allow a rebate in rates corresponding to the greater part of this saving, retaining for their own benefit a minor part of it. The statutory regulation of rates should embody this proposal.
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> 2. A similar estimate should be made of the saving in railway operating that would result if large combinations were effected of collieries and other wagon owners, who would consent to being supplied with wagons from a district pool. The wagons might be classified if necessary into two or three different types. All belonging to any one type would be used indiscriminately. Here also the greater part of the financial benefit that resulted should be allocated to the wagon owners, in the form of a rebate on the transport of all coal carried in such wagons. If legislation is necessary to authorise this, it should be enacted.
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> 3. In order that continuous attention should be given to these questions, and that progress should not be allowed to slacken for lack of stimulus, we recommend that the Ministry of Transport and the Mines Department should establish a Standing Joint Committee, with the title Standing Committee on Mineral Transport. It should consist of representatives of those Departments, with representatives of the railway companies, and the mineowners, and merchants. Power should be conferred on the proper Department of Government to make any regulations that might be found to be necessary, based upon the recommendations of the Standing Committee, for the standardisation of wagons. The Standing Committee should be required to make an annual report to Parliament on the progress made.

In Part III. of the report the position of employers and employees in the coal industry is reviewed at length. In considering the grievances of the miners the Commissioners warn us that account has been taken of the fact, in the first place, that the present grievances of the mining population are frequently viewed by them in association with grievances of the past. But if the past be forgotten, the grievances that remain are held by the miners to be serious enough. The wage scale is considered to be, at best, no more than adequate, and, in bad times, plainly insufficient. They contrast their own remuneration with the large dividends paid by colliery companies in times of good trade. If, however, the collieries fall upon bad times, the profits are low, or if public opinion complains that the price of coal is too high, and that other industries are suffering, the miners resent the suggestion that to lower their standard of living is the proper remedy. They believe from their working knowledge that many of the collieries are inefficiently managed, that output is frequently hindered by the failure to supply the hewer with sufficient tubs or other requirements, and they recognise that delays are caused by the bad lay-out of mines, owing to the leases of coal being dependent upon the boundaries of landowners' estates. They point to the large difference between the price of coal at the pithead and the price to the consumer, and they continually dwell upon the payment of royalties to landowners in return for no service. They hold that the accident rate is still far too high, and there is much discontent with the conditions of housing and at the absence of baths at the pithead.

On their side, the employers resent the accusations levelled against them, which in the main they feel to be unjust. The abuses of bygone days which have long disappeared have nothing to do, they consider, with the affairs of the present, and they hold that the Miners' Federation, so long as it adheres to the policy of nationalisation, does not desire to come to agreements with the employers, but to destroy them—to secure their elimination from the industry altogether. If wages are lower than they might be, or prices higher, they attribute the cause mainly to the action of the men themselves in insisting upon hours of labour so short as to make the working of the mines unduly costly. They point to an obstructive attitude towards the introduction of machinery, to frequent absences from work, and to unauthorised stoppages of a whole mine in order to secure the remedy of some trifling grievance.

Yet, on the whole, the Commissioners do not think that such mutual hostility as there is between the central bodies is a true reflection of the spirit that prevails in the country at large, and they were impressed by the expressions of goodwill that they heard in the course of their visits to mines. After these preliminary observations, we are brought to the consideration of separate points in successive chapters. Of these, output is the first to be considered. Output per head of all persons employed in mining has fallen from 319 tons in 1879 to 1833 to 217 tons in 1925. There is in many quarters an impression that the British miner could and should work harder than he does, and that the difficulties of the coal industry are in part at least due to a growing practice of ca'canny. The Commissioners notice, however, that none of the expert witnesses who came before them believed that there was anything like organised or general restriction of output by the miners, and that the few cases in which it occurred were due to particular conditions. They deprecate the practice of comparing the output of continental and American miners with British miners, and indicate the physical difference in the mines which causes such disparity in the output. But even when comparison is made for the same country or the same district at different dates, the decline in the yearly output per person employed is no evidence of restriction of output by the miner. The figure of yearly output per person employed above and below ground is, for various reasons, a dangerous one to use. One of the factors which may readily lead to wrong deduction is the proportion of hewers or face workers to those engaged at the surface or underground on other occupations than at the face. As compared with the conditions in 1905, the output of every 100 persons at the face has now to provide a living for 31 additional persons employed away from the face, either below ground or above ground. In 1905, for 100 persons at the face there were 114 others, but in 1924 for 100 persons at the face there were 145 others.

The broad result arrived at by the Commission from such figures as it was able to obtain suggests that there has been no marked change in the personal efficiency or industry of the workers at the coal face, and that whatever change there has been has probably been a change in the direction of increasing their output per hour. This is a natural consequence of the decreased number of hours in the day. Moreover, the Commission heard nowhere of opposition by the miners to the introduction of machinery. There is, they say, often a natural dislike among the older men to new-fangled notions and the problem of fixing new piece-rates has always to be solved, but, generally speaking, if the manager seriously wishes to try machinery he is able to do so. "But the physical difficulties to be faced are serious, and nothing but the most strenuous application of technical skill with the

fullest use of capital can meet them. It is not sufficient to possess, as we believe this country does possess, a body of mining engineers second to none in skill, experience, training and ingenuity; it is essential to secure that these qualities are applied and that the system of mineral ownership and the organisation of the mining industry are such as to give them unfettered scope. It is not sufficient that the best of our mines should be, as we think they are, unsurpassed in efficiency by those of any other country in the world. It is necessary that all our mines be brought as nearly as possible to the level of the best."

In the consideration of miners' wages, it must always be remembered that they are divided into two parts. First, the basis rate, which varies with the conditions of work, the thickness of seam, for example, and therefore varies from district to district, from mine to mine, and even from one part of a seam to another, and the percentage increase upon this basis rate, which is determined not for particular mines, but for large areas, and allows for the economic condition of the industry, the value of money and the standard of living of the miners. It must further be recalled that in the 1921 and 1924 agreements, two main principles are embodied. First, that of a minimum wage, and, secondly, that of an economic wage determined scientifically. When the second of these two principles was introduced in the 1921 agreement, it was hailed by expert observers as a landmark in progress, but, unfortunately, it has not altogether fulfilled expectations. In the first place, there has been difficulty over wage ascertainments; that is to say, in defining the industry and determining its gross proceeds. The business of coal mining is not carried on in isolation from other businesses. The mines are associated with other industries, and in consequence it becomes difficult to determine fairly the proceeds of the mines themselves. If a mine-owner sells to an independent concern, he naturally tries to get the highest price, but if he is selling, so to speak, to himself, he is content with a lesser price, and the value of this "transfer price," as it is called, has frequently to be determined arbitrarily. "It is," says the Commission, "no reflection on the mine-owners as a body or upon the impartiality and efficiency of the joint accountants, if we think that a radical change in the treatment of transfer prices is needed to place the wage ascertainment beyond suspicion."

As a result of full consideration, the Commissioners are not certain that any examination of colliery books by accountants after the prices have been entered by the mineowners can absolutely counteract this probable tendency to depression of coal prices through selling under associated conditions. They are inclined to think that the only real solution of the difficulty is to leave out of account the transfer prices which the individual employer may enter in his books, and to procure officially and publicly from time to time through some impartial authority in each district what shall be taken as the market price at that period of every kind of coal sold in the district. They furthermore suggest that by suitable legislation, colliery undertakings generally should be required to adopt schemes providing that if all profits distributed above a standard dividend on the existing capital, a fit proportion should be reserved as shares to be issued to employees. With regard to the minimum wage, the Commissioners say that whilst they regard it as absolutely necessary, both the present subsistence wages and the minimum percentages call for reconsideration, district by district. The fixing of a uniform minimum percentage for every district with reference to a single standard year, chosen arbitrarily like 1914, produces indefensible anomalies. The general principles for determining wages, whether economic or minimum, should be laid down by a single authority of national scope. There should be no abandoning of the principle of national wage agreements. There may be advantages, the two parties agreeing, in having a National Wages Board, which shall bring in also an impartial element outside the coal industry itself.

Chapter XIII. is devoted to the important subject of hours, and the Commissioners say "that they are unable to recommend the acceptance of the main proposals of the Mining Association to return to the 8½-hour day. If a reduction of wages is necessary to enable the industry to surmount its immediate difficulites, this reduction should be made directly and not indirectly by lengthening of working hours for the same remuneration. The evil of adding to the already excessive production of coal in the world would thus be avoided." They suggest, however, that it might be possible and beneficial at least in certain districts to allow the daily limit to be eight hours or even more, so long as the total of forty-two hours, plus one winding daily, was not exceeded in the week as a whole. "It was given to us in evidence," say the Commissioners, "that in many cases a five-day week of eight hours day, making forty in all, would be more productive than a six-day week of seven hours per day, making forty-two in all."

We must pass over several chapters, interesting as they are, on Safety and Health, Welfare, the Association of Workers and Profits, to turn in the space that is left to us to the conclusions of the Commission, and we must note particularly that the Commissioners recommend that the subsidy should not be continued. In this connection we quote the following passages:—

In our view the principle is wrong. If in any industry there is a labour dispute on wages, and a gap exists between the amounts that the employers are willing to pay and the amounts that the workers are willing to accept, or if demand declines and over-supply leads to low prices and production at a loss, it is wrong that the gap should be filled or the loss made good by recourse to the National Exchequer. It is indefensible that the people engaged in other industries should be taxed in order to provide profits for the employers or to maintain the wages of the workers in the particular industry affected—their own profits, and their own wages, being often no better, and sometimes worse. In the industry of coal mining, under subsidy, mineowners are now obtaining in some district profits per ton substantially higher than was usual in the industry before the war; and hewers are earning on an average 76s. for a full week, when in unsubsidised industries, shipwrights, for example, are earning 56s., and engineering fitters 57s.

If recourse is had to this means in one crisis in one trade—unless it is definitely ruled now to be inadmissible as a policy—there will inevitably be pressure to resort to it in another crisis or in another trade. The result would be destructive to the national finances.

We are glad to observe that the Mining Association are opposed to the principle of the subsidy and advocate its early ending.

The suggestions for meeting the present situation which are presented by this Royal Commission run as follows:—

1. Before any sacrifices are asked from those engaged in the industry, it shall be definitely agreed between them that all practicable means for improving its organisation and increasing its efficiency should be adopted, as speedily as the circumstances in each case allow. The measures to these ends which we consider practicable are stated in the preceding chapters of this Report, and will be summarised in the chapter that follows.

2. The owners should discontinue charging the miners as a body with deliberate attempts to destroy the prosperity of the industry, in order to compel its nationalisation. It is possible that there may be a small number of individuals here and there who are animated by this idea, but we are convinced that the point is without substance.

3. The owners should also cease to countenance accusations against the miners of restriction of output. Here again there may be sporadic cases, and when the rates of pay for new classes of work are under discussion, production may sometimes be purposely kept at a low level. But viewing the effect upon the industry as a whole, this point is quite unimportant.

4. The miners on their part should cease to attach exaggerated weight to losses of output due to failures of the management to provide the colliers with proper supplies of tubs, rails, timber or other requisites. Such cases undoubtedly occur from time to time, and a proportion of them are due to inefficient management. In particular places and on particular occasions an appreciable loss may be caused, both to the colliery and to the workman. But the effect upon output in general, and upon wages, is very small.

5. The mineowners should not refuse to engage in discussions on a national footing with the Miners' Federation of Great Britain. All the principal industries of the country conduct negotiations between employers and employed on a national basis, and we can see no reason why the mining industry should be an exception. At the same time, the conditions imperatively require that there should be a large degree of flexibility in the wage rates of the different districts. The Miners' Federation should recognise this, without detriment to the broad policy that the general principles should be laid down nationally.

6. As the first step accordingly, to the making of a new wage agreement, the Mining Association and the Miners' Federation should meet nationally. The procedure to be followed thereafter will depend upon the decisions then taken; it appears to us a reasonable course for the national conference to refer the question of minimum percentage and such other matters as they think appropriate to district associations to frame proposals. Those proposals would be submitted to the national conference for approval.

It is fitting, in conclusion, that the final words of the report should be quoted in full:—

The way to prosperity for the mining industry lies along three chief lines of advance: through greater application of science to the winning and using of coal, through larger units for production and distribution, through fuller partnership between employers and employed. In all three respects progress must come mainly from within the industry. The State can help materially—by substantial payments in aid of research; by removing obstacles to amalgamation under existing leases; as owner of the minerals by determining the conditions of new leases; by legislation for the establishment of pit committees and of profit-sharing, and in other ways.

The future depends primarily upon the leadership, and the general level of opinion, among the mineowners and the miners of Great Britain. In laying down our charge, we would express our own firm conviction that if the present difficulties be wisely handled, if the grievances of the one side and of the other be remedied, and a better spirit prevail in consequence between them, the mining industry, with the aid of science, will certainly recover, and even surpass, its former prosperity. It will again become a source of great economic strength to the nation.

Civil Marine Aircraft.

As at present organised, the services operated by Imperial Airways, Ltd., are entirely land plane services with the exception of that operated between Southampton and Guernsey. The Channel Islands service runs on Wednesdays only. The machine leaves Southampton at 10 a.m. and reaches Guernsey at 11.40 a.m. It returns at 1 p.m. and lands again at Southampton at 2.40 p.m. The single fare between Southampton and Guernsey is £3 and the return fare £5 10s. It would appear that there is no great demand for the service, and were it not that by its contract with the Government Imperial Airways is required to maintain a regular seaplane service, this branch of the company's activities would probably be reduced or stopped altogether.

Abroad much the same position is to be observed. With very few exceptions all the established air services are operated by means of land machines.

On the constructional side relatively little attention has been paid to civil marine aircraft. In this country plans have frequently been projected for the construction of seaplanes or flying boats expressly for the carriage of passengers and goods, but in general the plans have remained in the design stage. Excluding marine craft converted for civil use, machines of this class, so far as we know, have been produced only by two firms, the de Havilland and the Supermarine Companies, although on the Continent a considerable number of successful designs have been produced. This condition of affairs is noteworthy in view of the fact that British designers have from very early days been actively and conspicuously associated with the evolution of seaplanes and flying boats for naval and military use and for racing purposes.

In a paper which Mr. O. E. Simmonds, of the Supermarine Aviation Works, read last week before the Institution of Aeronautical Engineers it is suggested that the Air Ministry competitions for commercial aircraft in 1920 threw a blight over the development of civil marine machines by insisting upon their possessing amphibious characteristics. The amphibian has to carry many pounds of non-paying load in the gear fitted to enable it to alight on land. Other factors help to swell the loading with the result that the marine aircraft is notably inferior in the matter of weight-lifting efficiency to the land machine. For example, the D.H. 34, a land machine, carries 3·1 lb. of paying load per horse-power, while the Handley Page W. 8 machine can carry 3·85 lb. The Supermarine "Sea Eagle," an amphibian flying boat designed to carry six passengers, has, on the other hand, a power loading of only 2·19 lb. per horse-power. These figures suggest that the land machine is something of the order of 50 per cent. more efficient than the marine machine as a means of commercial transport. Mr. Simmonds is naturally not content with this result and is convinced that, with increased attention paid to the design and construction of marine aircraft for civil purposes, it ought to be possible to build a machine with an efficiency about as good as the D.H. 34 land machine. To that end he advocates the use of air-cooled engines, all-metal construction, and thick-sectioned monoplane wings without external bracing. In a seaplane of clean aerodynamic design the elimination of external wing bracing may easily result, Mr. Simmonds states, in a 15 per cent. reduction of the total drag. He believes that when an all-metal flying boat of about 50,000 lb. gross weight has been produced, numerous shipping lines will be found ready to substitute such aircraft for a proportion of their new tonnage requirements as their surface craft become obsolete. In this direction, he holds, lies the future of the flying boat.

The Nobel Oil Engine.

On Tuesday evening, March 9th, Mr. P. H. Wilson read a paper before the Institution of Engineers and Shipbuilders in Scotland on the development of the Nobel engine. The important pioneer work which was done by Ludwig Nobel, Ltd., of Petrograd, in the early development of the land and marine oil engine is sometimes overlooked. Mr. Wilson's paper gives, along with illustrations, a useful historical account of the various engines which were built by that firm in the period from 1897 until the end of the war, when the Nobel works were nationalised by the Soviet Government and the manufacture of Nobel engines was transferred to Nynäshamn, in Sweden. The first Nobel engine was completed in 1898, and was a single-cylinder four-stroke unit, designed to develop 20 brake horse-power at a speed of 200 revolutions per minute. It is interesting to note that this engine was similar in size and construction to the first British Diesel engine, which was built by Mirrlees, Watson and Co., Ltd., at Glasgow, in 1897, and which to-day is still performing useful daily service in the works of Mirrlees, Bickerton and Day, Ltd., at Hazel Grove, Stockport. In the twenty years which intervened between 1898 and 1918 the Nobel firm constructed many four-cycle and later two-cycle motors. Not only was experience gained with land engines, but important pioneer work was done on the marine type of motor, both non-reversible and reversible, in connection with engines built for Volga and Caspian Sea river boats and oil tankers. The naval work carried out by the firm embraced the construction of engines for gunboats, submarines and battleship auxiliary generating sets for the Russian Navy. The later history of the Nobel engine is perhaps more familiar to our readers. In our issues of January 27th and February 3rd, 1922, we published articles on the tests made on the 1600 brake horse-power four-cylinder marine engine, built by the Swedish Nobel Diesel Works, and in our first article a good deal of historical matter common to that of Mr. Wilson's paper, was given. This 1600 brake horse-power Nobel engine was later installed in the motor tanker Zoroaster, which has now seen a year's satisfactory service. Other manufactures of this same type of engine include Burgerhout's Shipbuilding and Engineering Company, Ltd., of Rotterdam, Mirrless, Bickerton and Day, Ltd., Hazel-grove, Stockport; the Niigata Engineering Works, Japan; and the firm of Nydqvist and Holm, of Trollhättan, Sweden. In our marine oil engine review of January 2nd, 1925, we illustrated the four-cylinder 900 brake horse-power Burgerhout-Nobel engine, which has since been installed in the oil tanker Black Sea, a vessel converted from a steamship to a motor ship, and belonging to the Black Sea Shipping and Oil Company, of London. Again, in our issue of January 1st of the present year we illustrated and described the four-cylinder 1000 brake horse-power Mirrlees-Nobel two-stroke single-acting oil engine, which generally follows the Nobel design, but has been modified in some respects to follow Mirrlees' standard practice. This type of engine has been adopted by Mirrlees, Bickerton and Day, Ltd., for slow-speed high-powered engines above about 800 brake horse-power. On the marine side we understand that designs for larger sizes of Nobel oil motors are in course of preparation, six-cylinder units of 5000 brake horse-power running at a speed of 85 revolutions per minute being contemplated.

EXCEPT for what was called the 4 per cent. increase made on certain classes of consignments to meet the consequences of the strike settlement of August, 1911, there was no general increase in railway rates from 1889 until the Government made it in 1917. Lord Churchill was, therefore, justified when, at the recent Great Western meeting, he said it was surprising to find that, notwithstanding the additional burdens on railway companies, their rates remained practically constant. Taking the whole of the company's purchases of materials there was an increase of 58 per cent. in their price in 1913 over that of 1897.

Railway Matters.

CABLE advices state that an excursion train from Cartago to San José, on the line of the United Railway Company of Costa Rica, on Sunday last, was derailed when crossing a river. Three crowded coaches fell down a steep embankment, and it is said that 248 passengers were killed.

WE are glad to hear that MR. L. B. BILLINTON, who was the locomotive superintendent of the London, Brighton and South Coast Railway until the grouping, has found what will evidently be congenial occupation. He has been made the general manager of R. Y. Pickering and Co., Ltd., carriage and wagon builders, Wishaw.

IN September last a mixed train got out of control when entering Douglas Station on the Isle of Man Railway, and ran into the buffer stops. The fireman, seeing that a collision was inevitable, jumped from the foot-plate, but was caught by the engine when it was overthrown and was killed. The original cause of the accident was that when shunting operations were being carried out at the previous station and the guard was on the ground the driver mistook a hand signal and started away. The trains in the Isle of Man have no continuous brakes and thus there was only the tender brake to control the train. The vacuum brake has now been adopted and is being fitted.

MENTION was made in this column on March 12th of the Railway Companies' Association having in hand the question of the apparent injustice of railway companies being taxed for the damage done to the roads by their competitors—the road motor omnibuses and the heavy motor lorries which carry merchandise traffic that formerly went by rail. A deputation which recently waited upon the Minister of Transport said that the companies were not in any way hostile to the development of road traffic as such, nor did they desire to be protected from fair competition, but the road haulier paid only a relatively small sum for the construction and upkeep of the road, and could select the most profitable business. Sir Wilfred Ashley promised to give the matter full consideration.

IT will be remembered that on December 7th last a road motor vehicle ran into the closed level crossing gates at Fenny Stratford and fouled the railway on which a train was approaching. As a result of the collision between the train and motor six passengers in the latter were killed and two other passengers and its driver subsequently died from their injuries. After several adjournments the Coroner's inquest into the death of the first six was completed on Monday last, when the jury found that the driver committed an error of judgment. A rider was added calling for better lighting at the crossing, but that would be contrary to some of the evidence given. Major Hall will now resume his inquiry into the matter as considered as a railway accident, and it will be better to await his report before definitely accepting the jury's opinion on the question of lighting.

THE rights of members of railway superannuation funds as affected by grouping were protected by the Railways Act, 1921. New schemes, to embody the various funds of the amalgamated companies, were necessary, and the London, Midland and Scottish secured an Act in 1924 to sanction its scheme. A Bill towards the same end on behalf of the London and North-Eastern Railway was before Parliament on the 3rd instant, but met with strong opposition, as new entrants were on a less favourable scale than former members. As Major Hills—a former director of the Midland Railway—said, "It was surely an impossible position that men working alongside each other should receive totally different scales of benefit." The spokesman for the railway company said that if the L.M. and S. scheme were followed an additional annual outlay of £120,000 would be involved. Only ten members voted for the second reading and the Bill was rejected by a majority of 331. Sir Evelyn Cecil then withdrew the similar Bill of the Southern Railway.

ACCORDING to the Board of Trade returns, the value of the railway material exported during January last was as follows, the corresponding figures for 1925 and 1924 being added in brackets:—Locomotives, £383,866 (£372,793, £209,483); rails, £118,228 (£228,930, £185,616); carriages, £131,064 (£158,920, £132,561); wagons, £385,338 (£368,121, £374,210); tires and axles, 22,507 (£42,297, £57,770); wheels and axles, £33,210 (£58,555, £45,630); chairs and metal sleepers, £80,053 (£26,425, £141,139); miscellaneous permanent way material, £85,962 (£124,003, £116,100); total permanent way material, £432,492, (£491,823, £559,951). The weight of the rails exported was 23,816 tons (24,566 tons, 21,841 tons), and of the chairs and metal sleepers 7959 tons (1939 tons, 11,738 tons). Of the locomotives shipped the following countries had the values named:—The Argentine, £103,204; South Africa, £47,637; India, £39,976; and other countries than the Argentine in South America, £7060. Of the rails exported India had to the value of £40,344; the Argentine, £34,924; South Africa, £34,611; Chili, £7072; Australia, £2952; and New Zealand, £2057.

THE new junction between Euston-square and King's Cross on the Metropolitan Railway, referred to in our annual article "Railways in 1925," was opened on Sunday last, thus giving up Circle trains access to the up widened line which has been equipped for electric traction up to and including Moorgate-street. Furthermore, as related in this column on February 19th, the down Circle line has been made available for electrical trains between Moorgate-street and Farringdon-street. Not only will up Circle trains be able to get on to the up widened line at King's Cross but they can do so at Farringdon-street as well. Down Circle trains on the down widened line must reach the Circle line at either Moorgate-street or Farringdon-street. The platform roads at Moorgate-street have been re-arranged so that four are now available for electrically-operated trains. The new junction at King's Cross is 1680ft. from the signal-box and quite out of the signalman's sight, but the provision of an illuminated diagram, whereon by means of indications actuated by track circuit, the occupancy of the lines is shown, completely meets that difficulty. The diagram also shows the direction approaching trains require to take

Notes and Memoranda.

DURING the past two years the nickel industry has shown a fairly steady recovery from the demoralised condition of the period of deflation which immediately followed the war. Careful and intelligent research by the technical staffs of the chief producers has found new industrial uses which have already proved almost sufficient to compensate for the heavy drop in the world demand which came with the Armistice.

THE intense competition of the Belgian radium industry, which works up at Oolen, near Antwerp, the ores derived from Katanga in the Belgian Congo, has, according to the *Chemical Trades Journal and Chemical Engineer*, made the position of the small French radium industry very difficult. The two French manufacturers—Armet d' Ile, at Nogent, and Henri de Rothschild, at St. Denis—which work with the more refractory Madagascar ores, are, it is understood, continuing production, and are trying to develop the production of radio-luminous paints.

THE country is spending some £15,000,000 a year on wireless, and the manufacturers are keeping pace with the demand for wireless apparatus. According to the *Wireless World*, American exports of wireless apparatus to England totalled £64,000 in 1922 and £100,000 in 1924. This is a very small slice of the British trade, and the prospects of any marked growth are not encouraging for American manufacturers. From every aspect, therefore, those who are empowered to conduct broadcasting in Great Britain and Northern Ireland after December 31st next will have cause for gratification at being placed in control of a "going concern."

A STUDY of heat flow meters for furnace walls is being conducted by the American Bureau of Mines, Department of Commerce. The purpose is to develop meters for the measurement of heat flow from kiln walls, boiler settings, surfaces of coal in mines, and similar problems. Seven meters, 2ft. square and about $^{3}/_{32}$in. thick, have been constructed, and have been partly calibrated by passing known rates of heat flow through them. When the calibration has been completed they will be available for special investigations on the flow of heat through refractory walls and for obtaining a measure of the radiation from boilers, kilns, &c., during an efficiency test.

ALTHOUGH motor transport is widely used both for passengers and goods, the actual number of motor cars in Morocco is not great relatively to the mileage and general good quality of the roads. The total number of cars was estimated at 2500 in 1921, and 2250 in 1922. Since that time the number has increased, but there is room for a much greater expansion. Passenger services are run on all the main routes on highly competitive lines. The majority of the cars used are of French make. Low-priced American cars are also a good deal used and an Italian car is rapidly increasing its sales. British cars continue to be almost unknown for general motoring purposes.

A COMMITTEE has been formed to organise research on blast-furnace coke at Sheffield University. The first object of the work is to identify and, it is hoped, specify those characteristics of different cokes which render them of greater or less value as blast-furnace fuels. Later—and for this work the co-operation of the coke manufacturers will be required—it will be necessary to investigate the means by which cokes of the required specification can most readily and most economically be made. The work is being carried out under the direction of Professors C. H. Desch and R. V. Wheeler in the Metallurgical and Fuel Laboratories of the University, where special apparatus has been installed for the purpose.

A PAPER read before the Wireless Section of the Institution of Electrical Engineers describes a visual direct-reading radiogoniometer capable of indicating the apparent azimuth of arrival of wave-trains the durations of which need not exceed 0·001 seconds. The special properties of the device, which comprises essentially a combination of directional aerials with a cathode-ray oscillograph, are discussed. Amongst these properties is that of giving simultaneous bearings on two or more stations transmitting simultaneously, on the same wave-length. A typical installation is described, and specimens of observations on the distribution in azimuth of received atmospheric disturbances are shown. A possible solution of the problem of navigational beacons is suggested.

A SURVEY of petroleum refineries, made by the American Bureau of Mines, Department of Commerce, shows a total of 509 refineries in the United States on January 1st, 1926. Of them, 352 refineries, with a capacity for treating 2,560,000 barrels daily, were being operated, while 157 refineries, with a total capacity of 290,000 barrels daily, were shut down. In addition, two refineries, of a probable aggregate future capacity of 5000 barrels per day, were under construction. A similar survey made by the Bureau of Mines as of January 1st, 1925, showed a total of 541 completed petroleum refineries, with a total daily refining capacity of 2,827,000 barrels, and six refineries, with a total capacity of 37,000 barrels per day, under construction. On January 1st, 1921, there were 415 completed refineries, with a total capacity of 1,889,000 barrels, and 44 refineries, with a total capacity of 77,000 barrels under construction.

A NEW form of fuel tank for aeroplanes, known as the Pescara bullet-proof tank, has been tested by the United States War Department at McCook Field. It is said to provide a means for the partial elimination of fire in aircraft. In addition to being bullet-proof and leak-proof, the tank is detachable, so that in the event of a forced landing, it may be dropped before the aeroplane reaches the ground. The Pescara tank operates by means of two rotating cylinders, one within the other, which form the walls of the tank. When the cylinders are pierced, a mechanism moves the inner cylinder round, approximately 4in., so that the holes in each cylinder are covered by the walls of the other. During the tests, although the tank was pierced repeatedly by machine-gun bullets, none of the contents, it is reported, leaked out. It is stated that the Pescara tank is about 40 per cent. lighter in weight than any other bullet-proof tank.

Miscellanea.

THE London and Home Counties Traffic Committee began on Monday last its inquiry into the complaints as to inadequate travelling facilities to and from East London.

THE amount received by the Post Office by way of fees for wireless receiving licences up to the end of last month, was, states the *Wireless World*, approximately £2,147,000, and the amount paid to the B.B.C. to date is £1,114,000.

A MESSAGE from Stockholm states that representatives of Vaesterbottens Gruvaktiebolag, which owns part of the rich ore deposits in the Skellefteaa district, are studying the possibilities of constructing furnaces for refining the ores on the spot.

ABOUT 31,343 tons of iron and steel manufactures, valued at £509,083, were produced in the Union of South Africa in 1924, an increase of 4279 tons in quantity, and £154,519 in value. In addition, 485 tons of iron castings, valued at £13,466, were produced, decreases of 83 in tonnage and £2621 in value.

PREVIOUS experience having taught the Australian Commonwealth Railway Commissioners that steel sleepers are the only kind suitable for railways in the Northern Territory, tenders have been invited for 352,000 pressed mild steel trough sleepers to be used on the Daly Waters extension of the Emungalan line.

A MESSAGE from Toronto states that the Ontario Hydro-electric Commission has secured authority to develop the Alexander Falls on the Nipigon River. The development will add 50,000 horse-power to the 65,000 horse-power already generated there, and will cost, it is estimated, in the neighbourhood of 7,000,000 dollars.

THE famous Hetton Colliery locomotive, which headed the procession of locomotive engines at the official centenary celebrations in July last, has been presented by Sir Arthur Wood and the Lambton Hetton and Joicey Collieries, Ltd., to the London and North-Eastern Railway Company for preservation in its museum at York.

H.M. TRADE COMMISSIONER at Toronto states that it is estimated that over 90,000 motor vehicles were purchased in Canada during 1925 and there were approximately 720,000 registered at the close of the year. Of this number, 642,500 were passenger cars, 69,950 commercial vehicles and 7550 motor cycles. The past year was the highest production year of the Canadian motor industry, the output of the various plants totalling in round figures 160,000 vehicles. Last year also eclipsed any other year in exports, as approximately 80,000 motor vehicles were sent to other markets. Thus, roughly speaking, half the domestic production in 1925 was exported—a new record in proportion as well as in volume.

IT is reported from Essen that an agreement is being prepared between a group of Ruhr industrialists and the province of Minas Geraes, according to which, as in the proposals made by the South American province five years ago, iron ore from Minas Geraes is to be smelted with coke produced in Brazil from German coal. To cover the cost of the coal and to utilise the ships carrying the coal from Germany, some of the iron ore from Minas Geraes is to be exported to Germany. The German industrialists wish to erect a modern blast-furnace plant, probably South of Bello Horizonte on the river Paraopeba, which will make use of already existing water power. The province of Minas Geraes is to take only a financial part in the undertaking.

SLIGHTLY more than twelve months ago the Railways Department of the State of South Australia decided to use motor vehicles on the roads and on the railways, states the *Melbourne Argus*. Twelve rail motors, with a seating capacity of fifty each, were imported from America complete, mainly as samples, and these vehicles have been doing excellent service. They have placed the passenger traffic on certain of the country lines on a payable basis, where formerly by the use of steam trains each line was gradually piling up the State debt. Since then the chassis of twenty-five motor rail cars, which, when complete, will be able to seat eighty passengers each, have been imported. The bodies will be constructed at the Islington (South Australia) workshops. The road motor service, which has been extended to different parts of the State, will be also increased.

THE announcement by the Postmaster-General that radio-telegrams will be accepted at any postal telegraph office for transmission to ships through the new wireless station at Rugby marks a further step forward in world wireless; the range of the new station will enable a direct service to be offered to ocean liners and other ships fitted with continuous wave receiving apparatus at any point on the high seas. Arrangements have been made for ships, when out of range of the normal British ship and shore service, to listen for radio-telegrams daily at 12.55 a.m. and, except on Sundays, at 12.55 p.m., when Rugby will give a list of the ships for which messages are on hand, indicating the order in which they will be sent. Ships will not be able to reply to Rugby, and in order to obviate possible temporary difficulties in reception, due to atmospherics or other cause, each message will be repeated in the period following its first transmission.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in February amounted to 502,000 tons, compared with 533,500 tons in January and 541,900 tons in February, 1925. Allowing for the shorter month, the rate of production in February was somewhat higher than in January, the daily rate amounting to 17,929 tons, compared with 17,209 tons in January. There were 146 furnaces in blast at the end of the month, a net increase of two since the beginning of the month—three furnaces having been put into blast and one blown out. The production includes 157,300 tons of hematite, 175,200 tons of basic, 123,100 tons of foundry and 22,400 tons of forge pig iron. The production of steel ingots and castings amounted to 703,800 tons, compared with 640,000 tons in January, and 652,300 tons in February, 1925. The January production was, however, low, on account of the New Year holidays in Scotland.

MACHINE FOR RIPPING STEEL PLATES

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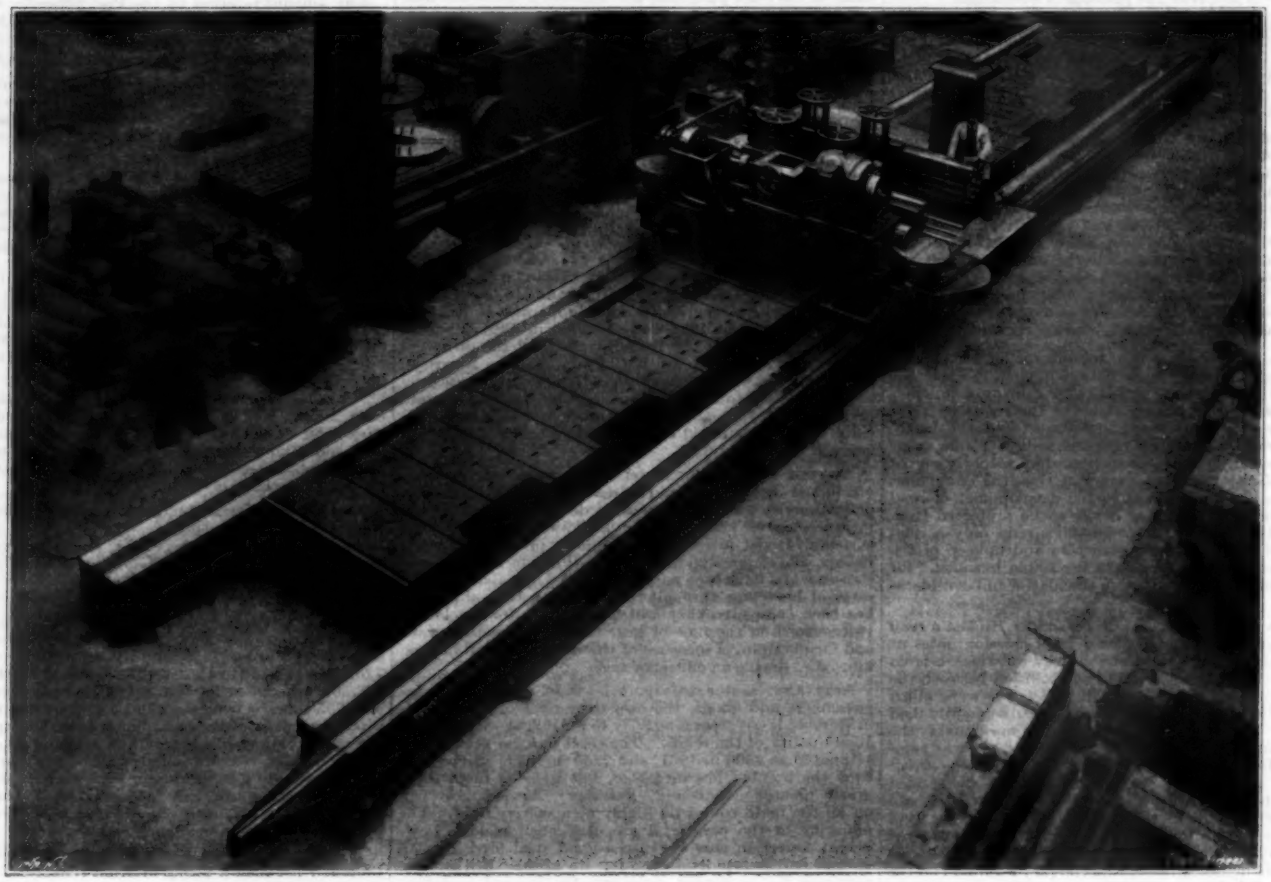
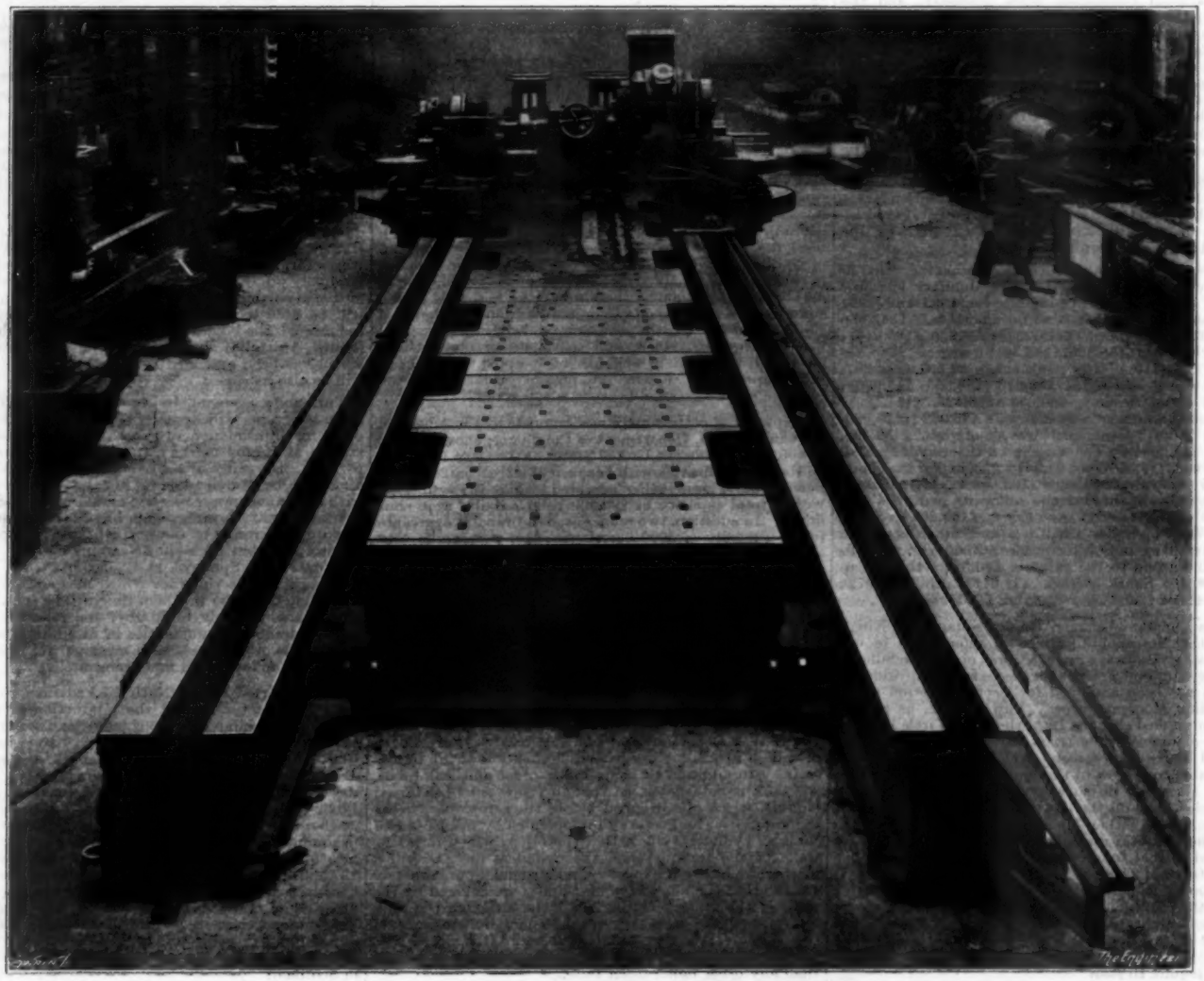
(*For description see page 333*)





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THE ENGINEER.

MARCH 19, 1926.

Electricity Supply.

THE Electricity Supply Bill (1926), and the report of the Committee appointed to review the national problem of the supply of electrical energy, have been published, and the Government's proposals as outlined by Mr. Baldwin in a recent speech at Birmingham are now set forth in more or less definite terms. The Bill carries into effect the main recommendations of the report, although some have been rejected. Naturally, the scheme outlined must only be regarded as a broad picture, subject to modifications and improvement, when the fully detailed and comprehensive survey which is advocated has been completed. It does not represent a definite proposal which would be adopted if the Bill were passed into law, for under the Bill a scheme would be prepared by a Board which would be constituted under its provisions. At the present rate of increase, viz., 19 per cent. per annum, the consumption of electricity would rise from the existing value of about 200 units per head of population to 500 units by 1940, or thereabouts, and it is estimated that under the new scheme current would be supplied at an average price of 1d. per unit, whereas under existing conditions it would not be reduced below 1½d. or 1¾d. per unit. The adoption of the scheme, it is claimed, would result in the former case in an annual saving of £44,500,000 on the national electricity supply bill when the consumption reaches 500 units per head, and £66,800,000 in the latter case.

The scheme, we need hardly say, is based on the generation of all the energy in certain selected stations, and the construction of main transmission lines interconnecting those stations and joining up with other stations and transmission lines. Apparently, there would be about fifty-eight main and secondary stations in all, forty-three of which are already in existence. While an element of control is considered to be necessary, it is not deemed to be essential that the stations should change ownership. The Committee concludes that there should be a virtual pooling of all electricity generated, as other methods would lead to artificial prices on a marginal or by-product basis. To obtain the virtual pooling, the contractual arrangements should, it is considered, be of such a nature as to secure that the owners of the selected stations will act as agents of the Board, all the operating expenses, including capital charges, being met by the Board, on whose account the energy will be generated, and the owners of the stations will repurchase such energy as they require for their own purpose at cost price. As the cost under the scheme, the report states, must inevitably be lower than that at which even the best stations can generate under present conditions, the Board will be able to supply these undertakers with current at a lower price than that at which they themselves can generate. The closing down of inefficient stations is expected to take place rapidly after the commencement of the new system, but as a precautionary measure the Committee recommends that the Commissioners should have power to require the closing down of stations, after a specified period, provided a supply can be obtained from the Board at cheaper rates. Apart from technical considerations, the report continues, the suggested segregation of generation can only be justified if it is undertaken as a public utility. It is therefore recommended that the capital required by the Board should be raised by means of electricity stock guaranteed by the State as to principal and interest, and that the Board should work on a non-profit-earning basis. Besides generation and main transmission, both of which will be under the control of the Board, there is the question of regional transmission. While at the present time the greater part of the industrial regions are covered by power companies which erect regional transmission systems, there are certain towns, generally of the larger class, which have protective clauses in their Acts, and in these towns the power company has no right to supply without written consent. The Committee recommends that the Board should be empowered to give direct supply to these towns, whilst other towns should be supplied through the power companies, the price of the bulk supply being controlled, so that these towns may obtain the benefits of the cheaper energy afforded by the Board. Parts of the country not covered by power companies can be divided into areas where there is a potential demand for power and purely non-industrial areas in which the Committee thinks that regional transmission and local distribution must be considered together. As it is considered that there are drawbacks to both power and distribution companies, it is thought advisable that in future there should be a new type of company with powers to supply for all purposes, but subject to a purchase clause operative after fifty years. The new type of company will be required to justify the area over which it applies for rights, but, subject to justification, the area would be unrestricted. The larger companies would be responsible for regional transmission, whilst the Board would apparently be authorised to lay down secondary lines to the smaller companies. As far as power companies are concerned, it is advocated that the price to be charged by them for bulk supplies should be confined to the cost price plus a reasonable return on the capital expended for the particular supply; whilst for other supplies they should be subject to a revised maximum price clause. The power to make up back dividends to the standard 8 per cent. should, it is considered, be repealed. Provision is made in the Bill for the utilisation of waste heat, which, of course, has now been under consideration for a long time.

Distribution which, as everyone knows, is an important factor in the total cost of current supplied to the consumers, will not in the ordinary course of events be dealt with by the Board. A great deal has been said and written about the importance of reducing distribution costs, and the advantages to be derived from standardisation, but it does not appear that the new scheme will have any influence on the cost of distribution. It leaves those who undertake distribution free to indulge in any extravagances they may think fit. It has often been argued that the standardisation of frequency would not only facilitate linking up, but would also reduce manufacturing costs. If, however, those who distribute the electricity are free to supply direct current, single-phase, two-phase or three-phase current at various voltages, we fail to see how the manufacturers are going to turn out motors, &c., under very much better conditions than they do at present. Quite a number of supply undertakings which under the new scheme will continue to distribute current, introduce plant between the generating station and consumers' terminals which gives rise to very appreciable losses, and there is nothing in the Bill to prevent them doing so in the future. In Appendix II. accompanying the Report it is stated that it is considered that for the country as a whole a distribution efficiency of 85 per cent. is sufficient to allow for all losses from the high-pressure bus-bars of the generating stations to the consumers' terminals, but in the absence of control on the distribution side of the business we fail to see how the promoters of the scheme can ensure that the best efficiency possible will always be obtained. The efficiency of some

sub-stations alone does not equal 85 per cent., and if the practice of converting current is to be allowed to continue without restriction, the total loss between distant stations and the consumers' terminals is likely in many cases to be considerably greater than the figure specified. We are aware, of course, that within recent years there has been a marked tendency to employ three-phase distribution, but that tendency is not by any means universal. If the main lines of the railways are electrified, as the promoters of the scheme apparently contemplate, direct current will probably be adopted, because the electrical manufacturers in this country know very little about anything else, and it would be interesting to know what the efficiency is likely to be between the bus-bars of distant stations and the terminals of the motors on the trains. If the Government considers it necessary to exercise control over the generating side of the electricity supply business of this country, then surely it should attend to the distribution side as well, for it is now generally recognised that cheap and efficient distribution is every bit as important as efficient generation.

Under the Bill the Board may require any authorised undertakers or the owners of any selected station "to amend or alter the frequency employed in their undertaking or station if and so far as such amendment or alteration is required to effect the standardisation of frequency, provided by or under the scheme or to effect such standardisation of frequency as the Board with the approval of the Electricity Commissioners may think expedient, subject to the payment to the authorised undertakers or owners of any expense which they may properly incur in carrying such requirements into effect, including the cost of altering or replacing plant belonging to consumers." A detailed investigation, first, of the Clyde area, and subsequently of the South-West Midlands, has apparently led to the conclusion that the gross cost of standardising frequency would be under 10½ millions, while the estimated net cost, after allowing for expenditure represented by useful additions to the plant capacity of supply undertakings, should not exceed 8 millions. As we have said before, this estimate is, in our opinion, very much on the low side. For Birmingham alone Mr. Chattock has fixed the cost at no less than £6,700,000, and applying this estimate to the rest of the areas in the country using periodicities other than 50, he has concluded that the total cost would be approximately £27,000,000. A detailed survey of the Birmingham district is apparently now being made.

There is a good deal in the report about the sale of electricity, but no new suggestions are put forward. Contrary to what we originally thought, it is not intended to create an efficient sales organisation. The task of selling the current is apparently to be handed over in many cases entirely to those who originally had the job of generating it, and who, in our opinion, are, generally speaking, incapable of efficiently grappling with such work. The freeing of officials from the dual task of engineer and manager, the report states, should be regarded, not as a lowering of status, but as opening up a possibility of even more fruitful endeavour. In our opinion, the dual post of engineer and manager should never have been created, for it rarely happens that one man carries out the two duties in the most efficient manner.

Some day a cheap and abundant supply of electricity may be made available in this country, but we fear that by the time it arrives many of us will no longer need it. While British engineers did the best part of the pioneer electrical work, Great Britain is at present in the unfortunate position of having a very unsatisfactory electricity supply system, and a very low consumption of electricity per head of population, as compared with many other countries. The fact that a great amount of pioneer work was done in this country may to a large extent be responsible for the hopeless chaos that has been created, but there have also been other contributory factors. The existence of most of the 25-cycle plant, for instance, is attributable to the fact that at one time 50-cycle rotary converters were unsatisfactory. Accordingly, engineers built 25-cycle stations, whilst the rotary converter troubles were being overcome. Many of the existing difficulties can, we believe, be traced to lack of foresight and the whims and fancies of engineers who were free to do whatever they pleased. It is time that some endeavour was made to remedy the defects of the existing system, but let it be remembered that finality in electrical engineering has not been reached. The work must proceed in steps, and no doubt many existing ideas will have to be changed from time to time, whilst possibly new developments may alter the whole situation. As we said at the outset, the scheme outlined in the report on which the Bill is based is only to be regarded as a broad picture, which may eventually have to be considerably modified.

Royal Naval Engineer Officers.

WE desire to direct the attention of our readers to the notable memorandum on the status of Royal Naval Engineers, which we publish to-day on another page. It was drawn up by a Committee composed of members of the great engineering interests, and is a dignified protest against the action of the Admiralty last autumn, when by a Fleet Order it deprived Engineer Officers of military rank and all that it implies. The memorandum was sent to the First Lord of the Admiralty shortly after a deputation had waited upon him and had received a sympathetc hearing. The reply is therefore all the more disappointing. In a letter dated February 26th, the Admiralty says that "Mr. Bridgeman has come to the conclusion that no real grounds for grievance have arisen as a consequence of the Admiralty Fleet Order." How he could have reached that conclusion in face of the facts contained in the memorandum—facts which are not challenged—we are at a loss to understand, and we are in no degree surprised that the Committee of the Institutions has expressed itself as "extremely dissatisfied" with the reply. The matter cannot be allowed to rest where it is, and every engineer, whether engaged in civil or military occupations, will rejoice that the Institutions have decided to take steps to call the attention of the public to a gross injustice to a body of men who not only during the war but on hundreds of peaceful occasions, have won the honour and respect of their countrymen. We can scarcely believe that when all the facts are laid before the House of Lords and the House of Commons, the action of the Admiralty and its persistence in it will be allowed to remain. It becomes every day more and more imperative that the status of engineers should be raised in the interests of general welfare, and this deliberate act of the Admiralty by which it is lowered must be deprecated by every thoughtful person.

Obituary.

JAMES ROSSITER HOYLE.

WIDESPREAD regret will be felt at the death of Mr. James Rossiter Hoyle, a former Master Cutler at Sheffield, which occurred on Sunday last in a London nursing home.

James Rossiter Hoyle was born in Manchester in the year 1856. He was the son of the late Mr. Williams Jennings Hoyle, a member of an old Yorkshire family, who held positions of importance in the firm of Sir W. G. Armstrong and Co., Ltd., and was for some time chief assistant to Sir Andrew Noble. The younger Hoyle, after receiving his early education privately, studied for some time at Owens College, Manchester, and then was sent abroad to acquire a knowledge of the French language, at which he eventually became very proficient; a fact which was to have a very considerable influence on his career. On returning to this country, he entered the service of his brother-in-law, Mr. C. W. Burton, who was the agent for several steel firms, and himself a manufacturer doing business with the Continent. In connection with this business Mr. Hoyle again went abroad, this time to Paris, where he obtained a large amount of valuable practical experience, as well as acquiring a useful acquaintanceship with the business side of his profession. Incidentally, also, he perfected his mastery of French. One of the branches of engineering to which he had given a considerable amount of study was that of gun and projectile making.

It happened that about that time—1881—Thomas Firth and Sons, of Sheffield, had entered into an important contract with the French Government for the supply of gun forgings, &c. This contract having arisen out of the fact that the French Government had imposed new and difficult tests connected with the manufacture of gun steel, which tests the French makers refused to accept, but which Messrs. Firth's found themselves able to guarantee. It happened, too, that the late Mr. Charles Henry Firth had met Mr. Hoyle in business, and, recognising how valuable a young engineer, with an extensive knowledge of French and of French business methods, such as Hoyle had, would be to his firm in connection with its French contract—especially as the young man knew something of guns and gunnery—offered him employment. Hoyle accepted and went to Sheffield to begin a connection with the Firth firm which was to last for forty-five years.

Although quite a young man at the time—he was only twenty-five or so—quickly he began to make his influence felt. He was soon given the post of manager of the gun works, to which, under his superintendence, considerable extensions were made, some of them designed to increase the firm's capacity for making big guns. In France he had witnessed experiments with a novel type of armour-piercing shell, which was considered to be a decided advance on any previously existing projectile of the same type. After experiencing some considerable trouble, he persuaded Messrs. Firths to acquire manufacturing rights, and to take up the manufacture of this shell. He was deputed to visit France and obtain the particulars necessary for the setting up of a factory for making it in this country, and when he returned he at once busied himself with erection and putting to work of the building.

Another departure for which Mr. Hoyle was responsible was the equipment of an extensive engineering factory at Riga, which his firm carried out several years before the war. The establishment of this factory, at which steel goods, such as files, tools, &c., were produced, was considered by him to be of vital importance because of heavy duties imposed on imported goods by Russia was threatening to put a stop to the valuable trade which the firm was doing with that country.

During his long association with Messrs. Firths,

JAMES ROSSITER HOYLE

Mr. Hoyle identified himself with its interests to the exclusion of everything else. For it he visited all parts of the world, seizing every opportunity of expanding its business and doing everything he could to maintain its prestige. It is said that his business journeyings took him twice round the world and into practically every country in Europe. As long ago as 1893 he was made a director of the firm, and, later, first, co-managing director with Mr. Lewis J. Firth, and then, when the latter went to America to see to the management of the Firth Sterling Steel Company, of Pittsburg, sole managing director. That position he continued to hold until the end of the year 1921, when he retired, though he still continued to take an active interest in the affairs of the firm, nor, so we understand, had he entirely severed his connection with it when he died.

A great event in his life was that he was Master Cutler in 1913, and his year of office was a success in every way. He had previously been popular in Sheffield, but his conduct while holding office gained him still further popularity. Throughout his connection with the firm his relations with members of the staff and the workpeople were of the most cordial character, and on two occasions—first in 1907 when he had completed a quarter of a century in the firm's service and again in the year of his Master Cutlership—he was made the recipient of tokens of regard.

Mr. Hoyle was created a Justice of the Peace in 1912, and regularly took his place on the bench. In the midst of a very busy professional life, he still found time to play a prominent part in many local affairs, and was ever ready to give his assistance to benevolent and philanthropic movements. He was elected a member of the Institution of Civil Engineers in 1897, and of the Institution of Mechanical Engineers in 1887, later becoming a member of Council and Vice-president of that body. He was also a member of the Iron and Steel Institute, and was for two years President of the Sheffield Society of Engineers and Metallurgists. At the meetings of the last-mentioned

body he was a frequent attendant and speaker, and throughout his career he was always deeply interested in the scientific side of the steel industry.

SIR PHILIP WATTS.

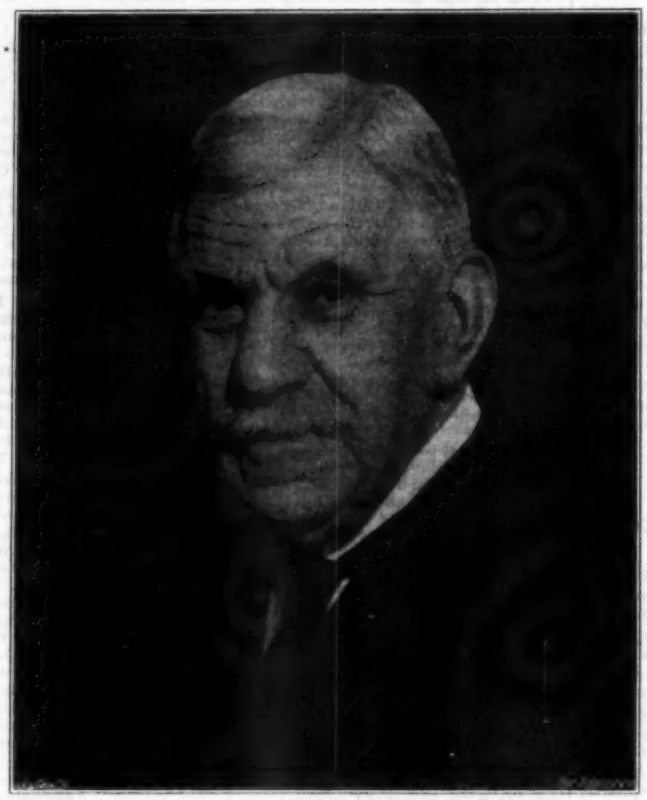
A VERY distinguished member has been removed from the ranks of the naval architects by the death of Sir Philip Watts, which took place, as the result of an attack of pneumonia, at his home in London on Monday last. Sir Philip was born on May 30th, 1846, so that he was within a few months of completing his eightieth year.

Philip Watts was the son of the late Mr. John Watts, of Southsea, who was chief assistant of Mr. John Fincham, a famous builder of warships, then Master Shipwright at Portsmouth Dockyard. Shipbuilding was in the blood of the Watts family. For generations before he was born Philip's forebears had been master craftsmen in ship construction, and there is no cause for wonder that the boy should have chosen to follow in their footsteps. As a fact, he became more famous in the profession than any of them. Of his scholastic training, we have no record, but at an early age he entered Portsmouth Dockyard as an apprentice. Having passed through the full course there, he was sent as an Admiralty pupil to the Royal School of Naval Architecture and Naval Engineering at South Kensington, which had been founded in 1864. In 1870, when twenty-four years of age, he left the School with the title of Fellow. The institution, which had already shown its ability to do good work, had produced one of its most noteworthy pupils! Thereafter he was associated for two years with the late Mr. William Froude in carrying out experimental tank work for the Admiralty. In 1872 he was transferred to the constructive staff of the Admiralty, becoming a draughtsman of the third class. For the next ten years or so he was employed, in various grades, in the designing of ships, and during that time he gave many signs of his capability of inventing devices for the special use of warships. It is to the credit of those in authority at the time that this trait, instead of being stifled, was fostered and encouraged, for in 1883 he was promoted to the grade of constructor, and a year or so later was specially attached to Chatham Dockyard in order to give him an opportunity of seeing by practical experience how his ideas might best be worked out.

Then, less than a year later, came one of the big opportunities of his life. In October, 1885, Sir William White, having accepted the position of Director of Naval Construction, the position he had previously occupied as organiser and director of the warship building department of Sir W. G. Armstrong and Co.'s works at Elswick, was offered to Watts, and accepted by him. Of his work during the next sixteen years much might be written. It was a period of transition in warship design, and in the evolution of new types he played a prominent and successful part. The special qualities with which he sought to endow all the vessels that were built under his direction were speed and gun power, and he was remarkably successful in combining these two antagonistic attributes; antagonistic because extra gun power means extra weight, and extra weight calls for greater power to get the speed. Vessels of his design went to nearly every navy-owning country in the world which had not facilities to construct its own warships. He was largely instrumental in creating Japan's modern navy, that country not having reached full tide in naval construction, and the famous cruisers Asama, Idzumo, Iwate and Tokiwa were built to his designs. Other countries which were supplied with warships during his period of control were the Argentine, the cruisers Buenos Aires, Nueve de Julio and 25 de Mayo; Brazil, the cruisers Barroso and Republica; Chile, the cruisers O'Higgins and Esmeralda; Norway, the coast defence ships Norge and Eidsvold; Portugal, the Dom Carlos I.; and Turkey, the cruiser Abdul Hamid. It must not be forgotten that during this period some score of vessels were also built for the British Navy. All these vessels were highly successful, and they steadily strengthened Watts' reputation as a thoroughly capable designer. He showed himself to be an adept at obtaining a maximum in gun power and speed with a minimum of displacement, and his success in this direction evoked universal admiration. In other departments, too, he was always willing to adopt new methods, provided that he was satisfied that advantage might be obtained from them, and it was he who, with the object of reducing vibration, was the first to introduce into warships four-cylinder triple-expansion engines.

In 1902 Sir William White, having held the office of Director of Naval Construction for sixteen years, found himself forced by failing health to relinquish it. The Admiralty, taking the same course as when he had been chosen, again went to the Elswick firm, which had by then become Sir W. G. Armstrong, Whitworth and Co., Ltd., to find his successor. It was then, and is still, agreed that they could not possibly have selected a better man for the work than Philip Watts. For one thing, he had had more experience in the design of large warships than any living naval architect, and he was known to possess that courage which enabled him to depart from beaten paths when necessity or advisability called for such action. He was recognised as one not bound with the steel bands of tradition. And so Philip Watts went to the Admiralty to embark on the third, and in many ways the most important phase in his career.

From the very first he was busily engaged. First of all, he had to design two battleships, the Agamemnon and the Lord Nelson, and after them the two armoured cruisers Black Prince and Lord Nelson, and, in addition, seven other cruisers of two types. Then came the advent of Lord Fisher as First Sea Lord in October, 1904, and what may be termed the Dreadnought Era. This is no place to discuss the question as to who was the first and true inventor of the "one gun ship." It must suffice here to say that Fisher had in view the advisability of adopting for first-line ships vessels armed with the largest possible number of large-sized guns, and no secondary armament saving quick-firing guns of small calibre. Hesitating, perhaps, to rely entirely on his own judgment in the matter, he proceeded, as one of his first acts in taking up office, to appoint a committee to go thoroughly into the question. That committee consisted of naval officers of high rank, and Philip Watts, together with civilian naval architects and shipbuilders, and included also Lord Kelvin, so that the advice of the greatest living physical scientist might be available. As the result of the findings of these investigators, Watts was instructed to design the battleship Dreadnought and the battle-cruiser Indomitable.



SIR PHILIP WATTS

Here was a task which was entirely to Watts' taste. He could start *de novo*, as it were, and work out the vessel on entirely new lines. If he did not originate the idea of the one-gun ship, he at all events created the Dreadnought, and Lord Fisher once said of him that "the Dreadnought could not have been born without Sir Philip Watts." He succeeded in producing a ship which was entirely unlike anything previously built and which was destined to revolutionise battleship and cruiser design. The Dreadnought, which was first commissioned in 1906, mounted no less than ten 12in. 45-calibre guns, and with a displacement of only 17,900 tons developed on trial a speed of as much as 21·6 knots, her designed speed being 21 knots. How great an advance this was on anything that had gone before may be realised by the fact that the King Edward VII., which had immediately preceded her, and which had a tonnage of only 1150 less only achieved a maximum speed of 18½ knots. This increase of speed had been rendered possible by another innovation, the employment of the steam turbine—the first occasion on which this form of propulsion had been used in a battleship—in conjunction with the water-tube boiler. The Dreadnought was, in other ways, a notable vessel. She was, by reason of her high freeboard forward, a particularly dry and seaworthy ship, and her rectangular construction amidships made her comparatively free from rolling. Her construction was hurried on so as to make it certain that she should be in commission before any rival nation could copy her in the event of details of her design having leaked out, and she was launched and fitted out in record time, every precaution—even to the extent of constructing her within "closed doors"—having been taken to prevent any unauthorised person from obtaining access to her.

The Dreadnought was quickly followed by the Indomitable—the first of a long line of battle-cruisers—which was completed in June, 1908. We have not space here to discuss the effect which these novel departures had on warship design throughout the world, but the very fact that the type has persisted — though in a modified form—shows clearly enough that the steps taken in evolving them were on the right lines. The principal departure from the original design was in the secondary armament, the 4in. guns fitted in the Dreadnought being replaced in later vessels by guns of heavier calibre.

We shall not attempt to give even a list of the many vessels—battleships, battle-cruisers and others—which were designed by Sir Philip Watts during his nearly thirteen years' tenure of office, but they were many and of constantly increasing fighting power and speed. Two facts may, however, be cited. One is that of the total number of capital ships engaged in the Battle of Jutland on the British side, more than three-quarters had been designed by him, the remainder having been acquired by purchase from foreign Governments at the beginning of the war. The other significant fact is that in 1914 the average broadside fire of the twenty-five leading British battleships was 11,084 lb. per vessel, while the average figure for the twenty-five leading German battleships was only 6462 lb., a difference of 4622 lb., or over 2 tons.

We have so far only mentioned first-line ships. Sir Philip was, naturally, responsible for the designs of many other types of vessels, including, of course, fast light cruisers, torpedo craft, destroyers, auxiliaries, &c., in all of which many improvements were effected under his *régime*. It was, too, during his period of office that the Admiralty seriously took up the construction of submarines, all previously existing boats of that type having been built in private yards. How great were the advances made under his rule may be judged by the excellent accounts all these vessels gave of themselves during the four years of the war. We might go on to enlarge on this theme almost indefinitely, but enough has been said to show that Sir Philip occupied a position second to none among the list of distinguished holders of the position of Director of Naval Construction, which he filled with such outstanding ability. He was, indeed, the right man in the right position at the right time. As all naval officers who served in his vessels would, we are certain, be the first to testify. One of his chief endeavours was to give the men with experience—the men who had to fight in the ships when they were built—exactly what they considered was required in the best interests of the Service.

Sir Philip was at the Admiralty from February 1st, 1902, to August 1st, 1912. Early in 1910 he had expressed his desire to retire, but, fortunately for the country, he was persuaded to retain office for another eighteen months. Even then his valuable services were not entirely lost, for he was retained in an intimate consulting capacity for more than three years longer, that is to say, until the beginning of 1916. When he finally severed his connection with Whitehall, he took up private practice and was elected a director of Sir W. G. Armstrong, Whitworth and Co., Ltd.

Sir Philip was created Knight Commander of the Order of the Bath in 1905, and in 1909 enjoyed the

distinction of being made a Fellow of the Royal Society, of which for some time he was a member of Council and a Vice-president. He also held the honorary degrees of LL.D. of Glasgow University and D.Sc. of Dublin University. He was a member of the Institution of Civil Engineers from 1901, and served on the Council of that body. He became a member of the Institution of Mechanical Engineers in 1902. He was for long connected with the Institution of Naval Architects, of which society he was at the time of his death an honorary Vice-president. He was a member of the Council of the Society for Nautical Research, in which position he was largely instrumental in the reconditioning of the old Victory, and served on the Technical Committee of the "Save the Victory" Fund. He was also for some time the chairman of the Federation of Shipbuilders. For the sixteen years, 1894 to 1910, he was Lieut.-Colonel Commanding and Hon. Colonel of the 1st Northumbrian Brigade of the Royal Garrison Artillery Volunteers, and in that capacity he equipped and sent out to take part in the Boer War the six-gun Elswick Battery. It is perhaps not out of place here to relate that Mrs. Watts, as she then was, actually accompanied the battery to South Africa, and personally managed two hospitals, one at Murzenberg and the other at Colesburg.

It is impossible when reflecting upon the career of Sir Philip Watts not to recall at the same time his great predecessor, colleague and friend, Sir William White. Amongst naval architects, the two men enjoy a position of equal eminence, and each has to his credit a line of fighting ships which set the standard for the world for a long period of years. Yet there were vast differences between them. White sought the public gaze; Watts shrank from it. One was highly strung and sensitive, with a wandering and active imagination, which led him into excursions into varied intellectual fields; the other imperturbable, steady, concentrated, showing in his large frame and somewhat heavy face that calm resolution of purpose and quiet force of character which replaced the limelight activities of Sir William. Unlike White, Watts was not a frequent speaker, and spoke publicly only of those subjects immediately connected with his vocation. On them his views were always clear and definite, and were expressed with a calm assurance which impressed his hearers. As a rule, he was the embodiment of *suaviter in modo, fortiter in re*, but on occasion the strength of his convictions led him to speak with exceptional force and energy. Through and through, he was a sterling man commanding respect where he could not secure friendship, and leaving behind many to lament his departure, and not one who bears him a grudge or can complain of ought but generous and noble-hearted dealing.

Royal Naval Engineer Officers.

We are proud of the fact that we were amongst the first to draw attention to the retrograde step made in a Fleet Order at the end of last year by which Naval Engineer Officers are deprived of their military rank. Keen resentment is felt by engineers of all kinds at this treatment of the profession to which they belong, and, represented by their leading institutions, they are pressing the Admiralty to withdraw the Order and restore Engineer Officers to the status which until recently they enjoyed. On January 14th an influential deputation waited upon the First Lord of the Admiralty to make this request, and subsequently the memorandum which we reprint below was sent to the Admiralty. So far it has been without avail, for on February 26th the Admiralty wrote the following letter:—

Copy.
The Admiralty,
Whitehall, S.W. 1,
26th February, 1926.

Dear Sir,—I am desired by the First Lord to state that he has, in consultation with his colleagues on the Board of Admiralty, given very full and careful consideration to the representations advanced by the Institutions which took part in the deputation which he received on the 14th January, both on that occasion and in the subsequent memorandum dated 21st January which was forwarded to him.

Mr. Bridgeman has come to the conclusion that no real grounds for grievance have arisen as the consequence of the Admiralty Fleet Order No. 3241, issued in November, 1925, and he is confident that experience will convince the Engineer Officers of the Royal Navy that there was nothing in that Order derogatory to their position.

Yours faithfully,
(Signed) T. Fry,
Private Secretary.

Brig.-General Magnus Mowat, C.B.E.,
The Institution of Mechanical Engineers,
Storey's Gate, S.W. 1.

After most careful consideration of this letter the Committee of the Institutions sent the following reply:—

9th March, 1926.

Dear Sir,—I beg to acknowledge the receipt of your letter of the 26th February, copies of which have been circulated to the members of the Joint Committee of the Engineering Institutions concerned. This letter has been considered at a meeting of the Joint Committee held this morning.

I am instructed to inform the First Lord of the Admiralty, through you, that the members of the Committee are not only extremely dissatisfied with his reply to their carefully considered representations, but they view his statements with grave concern as a symptom of the attitude of mind prevailing at the Admiralty.

It is noted in your letter of the 26th February that the First Lord has consulted with his colleagues on the Board of the Admiralty, but I am desired to point out that my Committee realise that this Board does not include an Engineer Officer.

My Committee think it right to inform you at once that they intend to take steps, both in the Press and in Parliament, to make their views known to the public, and they further wish to state that they consider themselves free to publish the documents submitted to you and your reply of the 26th ult.

I am, Dear Sir, Yours very truly,
(Signed) Magnus Mowat.

T. Fry, Esq., Private Secretary to the
First Lord of the Admiralty,
Whitehall, S.W. 1.

There for the moment the matter stands, but steps are being taken to approach both Houses of Parliament with regard to it when the Navy Estimates are presented. We need hardly urge engineers to use all the influence that they can bring to bear to get the Fleet Order recalled and to see the men of their profession, whose magnificent work is universally acknowledged, restored to a status becoming the services which they render to their country.

ROYAL NAVAL ENGINEER OFFICERS.

Memorandum on Admiralty Fleet Order, 3241/25.

1. Members of the Engineering profession represented by the four Institutions:—

The Institution of Civil Engineers,
The Institution of Mechanical Engineers,
The Institution of Naval Architects,
The Institution of Electrical Engineers,

who speak also on behalf of:—

The North-East Coast Institution of Engineers and Shipbuilders,
The Institute of Marine Engineers,

having an aggregate membership of some 39,000 professional Engineers, have noted with grave concern the terms of the recent Admiralty Fleet Order No. 3241/25, whereby Engineer Officers are deprived of their hardly earned military rank by abolishing the "Military Branch," and then excluding them from the new category of "Executive Officers," which, with the exception of the Royal Marine Forces, thus becomes the sole repository of military rank in His Majesty's Navy.

2. Prior to the promulgation of the new Order, Engineer Officers (old and new schemes) were included in the Military Branch. "New Scheme" Officers (E) were only differentiated from other Executive Officers, *e.g.*, (N) (G) (T), by their relinquishment of the right to succeed to the command of ships, on specialisation as engineers. The "old scheme" Engineer Officers were further discriminated by the prefix "Engineer" to their military titles, *e.g.*, "Engineer Commander," and by having to wear stripes of purple distinction cloth on their uniforms.

3. The improved status had been reached by a long and difficult process of evolution, the more important stages in which commenced with the introduction of the Fisher-Selborne system of common entry and training in 1902 and ended on the 1st January, 1915, with the inclusion of all Engineer Officers in the Military Branch of H.M. Navy.

4. The last-mentioned reform met with universal approval, as the experiences of the War had deeply impressed the public mind with the vital importance of all branches of Engineering in the Naval Service, and a widespread feeling of resentment had been aroused by the limited recognition given in the Admiralty reports and Naval Despatches to the Services and sacrifices of the Engineer Officers and Engine Room Ratings.

5. We need not attempt to give here a detailed synopsis of the changes affecting Naval Engineer Officers, which have been made since the time when the importance of steam and other machinery on ships of war became evident. The detailed history of the whole period of reform is well known.

6. The reforms were, in a great measure, due to external pressure exerted by the Engineering Institutions, the Press, and public opinion. To some extent, they were arrived at by a process of trial and error, and their progress was marked by a succession of schemes, Admiralty Orders, amendments and rescissions; also by questions and debates in the House of Commons.

7. The cause of reform had no more capable and devoted advocate than the late Mr. Donald Barns Morison, whose remarkable series of papers read before Engineering Institutions during the period 1900 and 1915 exercised a potent influence on the course of events. These papers and the contributions to the discussions thereon by Engineers, Shipbuilders, and other men of undoubted knowledge and distinction, constitute a body of authoritative information and opinion, which, even to-day, may be consulted with advantage by those desiring to understand the subject.

8. The primary cause of what we consider to be the retrogressive step recently taken by the Admiralty is stated to be the breakdown of the Fisher-Selborne Scheme, in so far as it aimed at the eventual amalgamation of the Executive and Engineer Officers in one Military Corps of Naval Officers, and provided for the reversion of (E) Officers, *i.e.*, those who had specialised in Engineering—to Deck Duties on promotion to the rank of Commander, with the right to succession in the line of military command.

9. We desire to state, at this point, that the Institutions representing the Engineering professions never recommended that the Executive and Engineer Officers be amalgamated in the sense that their duties should be interchangeable, and that Engineer Officers should have the right of succession in the line of military command. As early as in 1901 the impracticability of such a scheme was foreseen, for the reasons subsequently given by the First Lord in his speech introducing the 1920–21 Estimates, quoted in Par. 17 of this Memorandum. Their recommendation was as follows:—

"We are of opinion that the primary cause of the unpopularity, inadequacy, and consequent inefficiency of the Engineering Department is its inclusion in the Civil Branch of the Service, whereby the authority and status of its Officers are rendered incommensurate with their duties and responsibilities. We, therefore recommend that the Engineering Department be embodied in the Executive Branch of the Service, and that its Officers be endowed with Executive rank accompanied, however, by Executive control restricted to their own Department."

10. A serious imperfection of the Fisher-Selborne Scheme, which should have been realised and rectified at the outset, was that it placed the senior old entry Engineer Officers of the non-military branch in a position of inferiority in relation to the very junior new entry (E) Officers of the military branch, whom they were expected to train and control. In time of peace this was bad enough, and it speaks well for the loyalty and discipline of the senior Engineer Officers that for twelve years, under both peace and war conditions, they performed their duties with undiminished efficiency and did their best to make the new scheme a success.

The injustice of such a state of affairs became so glaring under war conditions that a change had to be made.

11. On Christmas Eve, 1914, the twelfth anniversary of the Fisher-Selborne system of common entry and training, it was publicly announced by the Secretary of the Admiralty that, from 1st January, 1915, all Engineer Officers (old scheme) in H.M. Navy would be classified as part of the Military Branch, and with the addition of a distinctive purple band, wear uniform exactly similar to that of officers of corresponding ranks of the existing military branch.

12. From that time onwards one feature after another of the Fisher-Selborne Scheme has been obliterated, and nothing now remains but the condition of common entry and training until the Cadet is rated Midshipman, when specialisation takes place.

The principal stages in the process of change are briefly summarised below.

13. In 1916 the following special orders were issued by the Admiralty:—

(*a*) It is to be clearly understood that Officers after specialisation n Engineering retain the same status and are regarded as in the same position as other specialist Officers.

(*b*) Lieutenants appointed for (E) duties should not be called upon to perform ship duties to such an extent as to interfere with their Engine Room duties.

(*c*) As a War time measure only, Lieutenants (E) are not to assume command so long as there is a Commissioned Officer in the ship qualified to succeed in command. The above is not applicable to Lieutenants (E) serving in Submarines, who will assume command if the Officers senior to them are disabled.

14. By M Order 4047 of 1918, new conditions were imposed having the effect of restricting the right of (E) Officers to succeed to command of ships.

15. In March, 1919, Officers who had specialised in engineering prior to the issue of M.O. 4047/18 were given the following options:—

(*a*) To remain as they were, in which case they could not expect to receive Engineering appointments continuously. They would also be judged for promotion to the rank of Commander and Captain in competition with Deck Officers generally and not on their Engineering abilities, as would be the case if they accepted the regulations issued in M.O. 4047/18.

(*b*) To accept the application to them of the new regulations in M.O. 4047/18.

(*c*) To revert to Deck Duties forthwith.

The acceptance of option (*a*) would destroy any chance of future promotion beyond the rank of Lieutenant-Commander; of (*b*) would entail the eventual surrender of the right to succeed to command of ships; and of (*c*) would virtually close the Officer's career, as most of them would be too old to specialise in other Branches of the Service.

The majority of the Officers affected were naturally unwilling to accept any of these options, and were finally deemed to have accepted option (*b*) by default.

16. The First Lord, in introducing the 1920–21 Estimates, stated that final separation of the Officers of the Executive and Engineering Branches was considered to be essential. He said "there is a definite distinction both as regards knowledge and capabilities between those who are trained in the science of Naval War, and strategical and tactical methods of fighting, and those who are to deal with the upkeep and maintenance of engineering and mechanical appliances which are necessitated by the complex machinery and weapons of War." He emphasised the necessity of full co-operation and sympathy between the officers of the two Branches, and stated that it was believed this condition could be fulfilled by Common Entry and Training in the initial stages of an Officer's career. So that a due proportion of Officers of ability might be attracted to the Engineering Branch, the following decisions had been made and promulgated. He further indicated that:—

(*a*) The duties of the Engineer-in-Chief were to be extended and, in future, he would be held responsible for advice on all matters in connection with engineering policy and the instruction and training of the *personnel* of the Engineering Branch.

(*b*) When (E) Officers became available they were to be considered with Deck Officers for appointment as Admiral Superintendent of Dockyards. It was also stated that in future no (E) Officer would have the right to revert to the Upper Deck.

17. The First Lord, in his statement introducing the 1921–22 Estimates, informed the House that the policy inaugurated in 1920 had been further developed, and to this end it had been decided, *inter alia*:—

To provide that, in future, Officers who volunteered to specialise in (E) would do so earlier than had hitherto been the case. They would specialise on being rated Midshipman. It was considered that the period of common training at Dartmouth and as Cadets at Sea, was sufficient to give common understanding of the ideals and discipline of the Service.

18. The First Lord of the Admiralty and the two retired Admirals who have defended Admiralty Fleet Order 3241/25 in the Press, have stated explicitly that the changes made thereby do not impair the rank and status of Engineer Officers.

In reply to a question in the House of Commons, the First Lord of the Admiralty said:—

"Nothing in the new Admiralty Fleet Order pre-

judices any cadets who since that date have volunteered for engineering duties, as (E) Officers are already, under the Regulation in force since 1919, considered for promotion with other Engineer Officers, and not with Executive Officers, though they have remained in the Navy List on the general list of Executive Officers until reaching the rank of Commander. Indeed, promotion on a separate list is, under present conditions, very considerably to their advantage. As regards officers who volunteered prior to 1923, in a very few isolated cases—not more then five in all—the officers retained certain responsibilities as to military command, while the vast majority surrendered their option in this respect. Otherwise, the changes made are limited to the inclusion of officers' names in separate list in the Navy List and the direction that they shall now wear the same uniform as other officers employed on engineering duties. These are purely matters of practical convenience, arising from the fact—not now questioned, I think, in any quarter—that under present day conditions, the knowledge, duties and capabilities of Executive and Engineer Officers, though of equal importance, are definitely differentiated and cannot be combined as was once thought possible. The changes make no difference whatever to the position and status of the Officers under the various Regulations, and their relative rank and precedence, chances of promotion, rates of pay, &c., are in no way prejudiced, and I would earnestly deprecate suggestions that the changes imply inferiority in any shape or form, as such is not the opinion nor the intention of the Board of Admiralty."

In replying to supplementary questions, he said, further, that the object of the purple stripe was to distinguish the two sections, and that he could not understand why it should be regarded as in any way derogatory.

In concluding his replies, he said that the new Order only regularised changes that were effected in 1918, when it became clear that the amalgamation was not a success.

19. Having carefully considered the terms of the New Order, with an open mind and in the light of its antecedents, we are of opinion that it is injurious to the best interests of the Navy, and we are unable to agree that it is as innocuous as its authors and defenders contend.

20. It is indisputable that important changes have been made unfavourably affecting the rank, status and prospects of all entrants under the Fisher-Selborne Scheme, who elected to specialise in Engineering. Whether those changes do or do not constitute a breach of faith may depend on the powers legally reserved to itself by the Admiralty when the contracts of service were entered into. The fact remains that the officers and their parents and guardians are not getting what they were led to expect.

These Officers (E) have now been made non-military by their removal from the category of Executive Officers, and the abolition of the Military Branch in which Engineer Officers were formerly included. Furthermore, the new Order specifically limits to Executive Officers the eligibility to succeed to the command of a ship and to exercise military command.

The new entry Officers (E) are, therefore, deprived of real military rank, and it follows that they can hold only relative rank. Incidentally, this differentiation is emphasised by the new Regulation that they are, in future, to wear the purple distinction cloth worn by other Engineer Officers.

21. The Engineer Officers (old scheme) filled all the more responsible posts in the Engineering Branch during the War, and were largely instrumental in winning it at sea.

By the new Order, these Officers have been deprived of the Military rank and status which it took over fifteen years to win for them, which was at last conceded in tardy recognition of their unapproached efficiency, and of their all-important part in the splendid fighting condition of the whole fleet, as stated in the following telegram despatched by Lord Fisher to Mr. D. B. Morison on 27th December, 1914 :—

> "Your kind letter just received gratifies me greatly. The unapproached efficiency of our engineers in the Navy merited this tardy recognition of their all-important part in the present splendid fighting condition of our whole fleet, and this has been combined with an unswerving loyalty to a changing system which they one and all recognised to be for the public benefit and the good of the Navy. Your great engineering institutions immensely aided in propagating the realisation of the influence of engineering and engineers in a modern Navy. Machinery has no nerves and the 'All Oil' boilers don't get tired. No more hell in coaling ship. The unfailing propellers get us at top speed on the spot to a minute though 7000 miles away. Let us all humbly be thankful and all of us work harder for a glorious peace.
>
> "FISHER,
>
> "Admiralty."

22. There is no validity in the argument that "as the Military Branch has been abolished the Executive Officers might equally complain that they had been deprived of military status." Obviously the Executive Officers who command and direct the fighting of the ship must automatically hold real military rank and status quite independently of the existence of a so-called "Military Branch."

It is equally clear that the corps of Engineer Officers cannot possess military rank and status unless it is specially conferred on them, either by their inclusion in a "Military Branch" or otherwise.

It will not be seriously suggested that, as a consequence of the abolition of the Military Branch, the Executive Officers will cease to enjoy any of the Service authority and social distinction conferred on them as holders of the King's Commission in a Military Service.

23. In this connection it must be borne in mind that the King's Commission issued to Executive Officers differs materially from that issued to Officers of non-Military Branches, in that the former orders officers "to take charge and command," whereas the latter orders the officer 'to discharge the duty of —— and to be obedient to such as command," each in the rank to which the officer belongs. Executive Commissions have been issued to all (E) Officers right up to the present time, which shows that, even after the First Lord's statement on the 1920–21 Estimates, announcing the eventual final separation of the officers of the Executive and Engineering Branches, there was no intention to alter the status of (E) Officers. As explained above, these (E) Officers have, however, now been deprived, by the recent Admiralty Order, of real military rank.

24. The case is certainly not met by saying that "all officers in the Royal Navy except chaplains and medical officers, who are debarred by the Geneva Convention, hold combative status." That is a very different thing from military rank and status, both as a Service distinction and as an element of power to control the large bodies of men embraced by the Engineering Department, which, in the aggregate, represent about one-third of the total number of men under the command of Deck and Engineer Officers combined.

25. It should have been superfluous for us to emphasise the importance of Engineer Officers being included in the Military Branch. The manœuvring of the ship in peace and war is the joint function of the Executive and Engineer Officers, and it is they together who fight the ship in action. The senior Engineer Officer is second only to the Commanding Officer in the responsibilities he has to assume.

In action, the importance of the Engineering Department cannot be over-estimated. Throughout the War, the safety of the Fleet and of the country depended fundamentally on the speed of ships and the maintenance of ships' machinery in a state of instant readiness for action.

26. The late Mr. D. B. Morison, in his last Paper read before the North-East Coast Institution of Engineers and Shipbuilders on the 26th February, 1915, well said :—

> "It should have been evident to everyone who has carefully studied the various phases in the evolution of a modern Navy, that the revolutionary change in material from man-handled sails and small muzzle-loading cannon, to steam propulsion, highly mechanical heavy gun armaments, and complex mechanism in every department of a warship, should be accompanied, and must inevitably be followed by a correspondingly great complementary change in the character and organization of the *personnel*. It should moreover have been evident that, as a natural consequence, the nature and distribution of the duties of naval officers would have to undergo a radical change, that a new class of highly trained engineers would have to be embodied in the corps of officers, that their duties would be of a most important, special, and responsible nature, involving the command of large bodies of men, and that it would be necessary to invest them with executive authority and its corresponding rank and status."

27. We are strongly of opinion that the continual changing of the conditions of service of Engineer Officers and of their Service relationship to Executive Officers must react most unfavourably on the spirit and efficiency of H.M. Navy. Furthermore, it has a most disturbing effect on parents and guardians contemplating a Naval career for their sons or wards, and it has already had an unfavourable effect on the entry of naval cadets. There has also been a serious progressive shortage of volunteers to specialise in Engineering.

It is most desirable that the position should be stabilised with the least possible delay on sound lines giving some promise of permanency.

There would appear to be no real difficulty in the way of this being done, if due regard be paid to the various considerations stated above and it be frankly recognised that Engineering has not only come to stay in the Navy, but must necessarily be of ever-growing importance.

28. We fully share the view of the Admiralty that, in order to be efficient, Deck Officers and Engineer Officers must specialise in their respective duties.

We also agree that, as a consequence, Engineer Officers should not succeed to the command of ships.

On the other hand, we are entirely convinced that there is nothing in these conditions to prevent Engineer Officers from having military rank and status. They had it during all but the first five months of the period of the War, and with the most beneficial effects on the spirit and efficiency of the Engineering Departments of the Navy.

29. Our view is supported by the following extract from :—

> Admiralty Order 3333.—ENGINEERING.—NEW SCHEME OF TRAINING FOR SPECIALISATION OF OFFICERS. (C.W. 7434/22.—15.12.1922.)
>
> "Officers selected to specialise in (E) under this scheme will separate finally from Executive Officers, and though remaining in the Military Branch will forego all right to subsequent reversion to deck duties and to Military Command."

30. Attention may also be drawn to the following extract from the same Order :—

> "At the same time experience has shown that the efficient use of a Fleet in modern warfare demands the closest mutual understanding and co-operation between the Executive and Engineer Officers, and for this reason the present system of common entry for both Executive and Engineer Officers and for common training until a certain stage is reached will be continued."

We suggest that the reason given here, for the continuance of the system of common entry, is even more cogent as an argument in favour of equality of rank and status as between the Executive and the Engineer Officers. What psychological grounds can there be for the belief that "the closest mutual understanding and co-operation between Executive and Engineer Officers," who have studied and played as equals in boyhood, can best be secured by introducing, at the age of manhood and responsibility, a Service and social differentiation unfavourable to the Engineer Officer ?

31. It would seem to be appropriate to draw attention to the following message of the 16th June, 1916 :—

> "To Flag Officers, Commodores and Officers in Command of H.M. Ships of the Grand Fleet.
>
> "His Majesty graciously commanded that the following remarks made to Engineer Commander H. B. Moorshead of H.M.S. 'Iron Duke' on 15.6.1916, should be specially communicated to the Engine Room Departments in all ships of the Grand Fleet.
>
> "'The Engineering Departments have done very good work, and I wish you to make it known to the other Engineer Officers of the Fleet how much it is appreciated.
>
> "'You have below, during action, a great deal of strain and hard work, which has invariably been well done, and have not the same excitement and knowledge of events that they have on deck, while at the same time if anything happens you have little opportunity of reaching the deck.'
>
> (Signed) "J. R. JELLICOE,
>
> "Admiral,
>
> "C. in C."

32. For some reason, the disciplinary powers of Engineer Officers are very restricted.

In spite of repeated protests and representations on this subject, during many preceding years, it was not till 1911–12 that any power to inflict punishment was conferred on Engineer Officers, and then to an extent which appears to us insufficient considering their responsibility for the control of men in difficult circumstances.

33. The Order of 1st January, 1915, including Engineer Officers (old scheme) in the Military Branch, raised them partly from a position of inferiority, in which they had so long been repressed, and further reforms, *e.g.*, increased disciplinary powers and the abolition of the purple stripe were required to complete the readjustment of their position. By the new Order these Officers are again thrust back into the position of inferiority from which they were so recently raised by a tardy act of justice.

Furthermore, the Officers (E) are reduced to the same position by a violation of the conditions under which they entered the Service.

The position of inferiority in the Service, thus imposed on Engineer Officers, inevitably affects the social position and life of Engineer Officers and their wives and children, especially when residing in a Naval Port at home or abroad.

As it is, the Naval Engineer Officer is frequently ignored on such occasions as the reception of members of the Royal Family, or of the Royalties of foreign countries, or even of foreign Naval Officers. He is seldom included in invitations to the more important Service functions, official dinners, &c. On such occasions a junior Executive Officer, in command even of a small ship, or a Deck Officer, Second in command, is given precedence over Engineer Officers of high rank.

It is noted that the Navy List shows that the Naval Aides-de-Camp to His Majesty the King includes Deck Officers, of Captains or higher rank, to the number of twelve (excluding members of the Royal Family), and two each of Captain's rank from the Royal Naval Reserves and the Royal Naval Volunteer Reserve.

There are two Marine Officers who hold the same honour.

From the Chaplains' List there are six who have been made Hon. Chaplains to the King, and the Medical Branch has been honoured to the extent of five Hon. Physicians and five Hon. Surgeons to His Majesty.

No Naval Engineer Officer has been thus honoured.

Again, in the matters of accommodation and the rendering of marks of respect, the Engineer Officer is placed in a position of inferiority. For example, the ceremony of "Piping the side" for an officer boarding or leaving one of H.M. ships is not observed in the case of an Engineer Officer, no matter how high his rank, though it is carefully observed in the case of Deck Officers of much lower rank. The mark of inferiority is thus emphasised for all ranks and ratings to note.

It cannot seriously be maintained that such differences have no meaning, or that they have no repercussions inside or outside the Service.

34. The chief object of the Deputation is to protest against Admiralty Fleet Order 3241/25, and plead for its rescission. We are, however, aware of other important matters affecting the Engineering Department of the Navy, which would appear to call for early and thorough inquiry. Amongst these matters may be mentioned the following :—

The Direct representation of the Engineering Department on the Board of Admiralty.

Engineer Officers and membership of Courts Martial.

The control by technical officers of all technical work.

The higher shore appointments open to Engineer Officers.

35. In conclusion, we regret to state that we are in complete disagreement with the policy of the Admiralty reflected in the Fleet Order under discussion, and the attitude of mind towards the Engineering Department of which it is an expression. We believe we have demonstrated that the effects of the Order are very much more serious and far reaching than has been alleged by its authors and defenders.

There can be no satisfactory and lasting settlement of the questions at issue until Naval Engineering is viewed in truer perspective and treated with greater sympathy and understanding than have yet been extended to it.

In our opinion, it is essential that Engineer Officers should have real military rank and status, and that Executive Officers and Engineer Officers, both inside and outside the Service, should be equals, rank for rank, subject to the proviso that the right to command ships is confined to Executive Officers. This by itself confers a great advantage and distinction on Deck Officers.

In all other respects these two classes of officers should be equals, in the same sense that lawyers, doctors and Civil Engineers are equals. There should be no difference in uniform, such as the purple stripe, which has been so long associated with the idea of inferiority.

Nothing less than these conditions will attract and satisfy the class of man required to fill the position of an Engineer Officer in the modern Navy.

There was a time when we might have felt extreme diffidence in approaching the First Lord of the Admiralty with such representations and criticisms as we have ventured upon in this Statement.

The revelations made since the War have, however, so disillusioned us that we are no longer able to assume more or less subconsciously that all is well with the Navy.

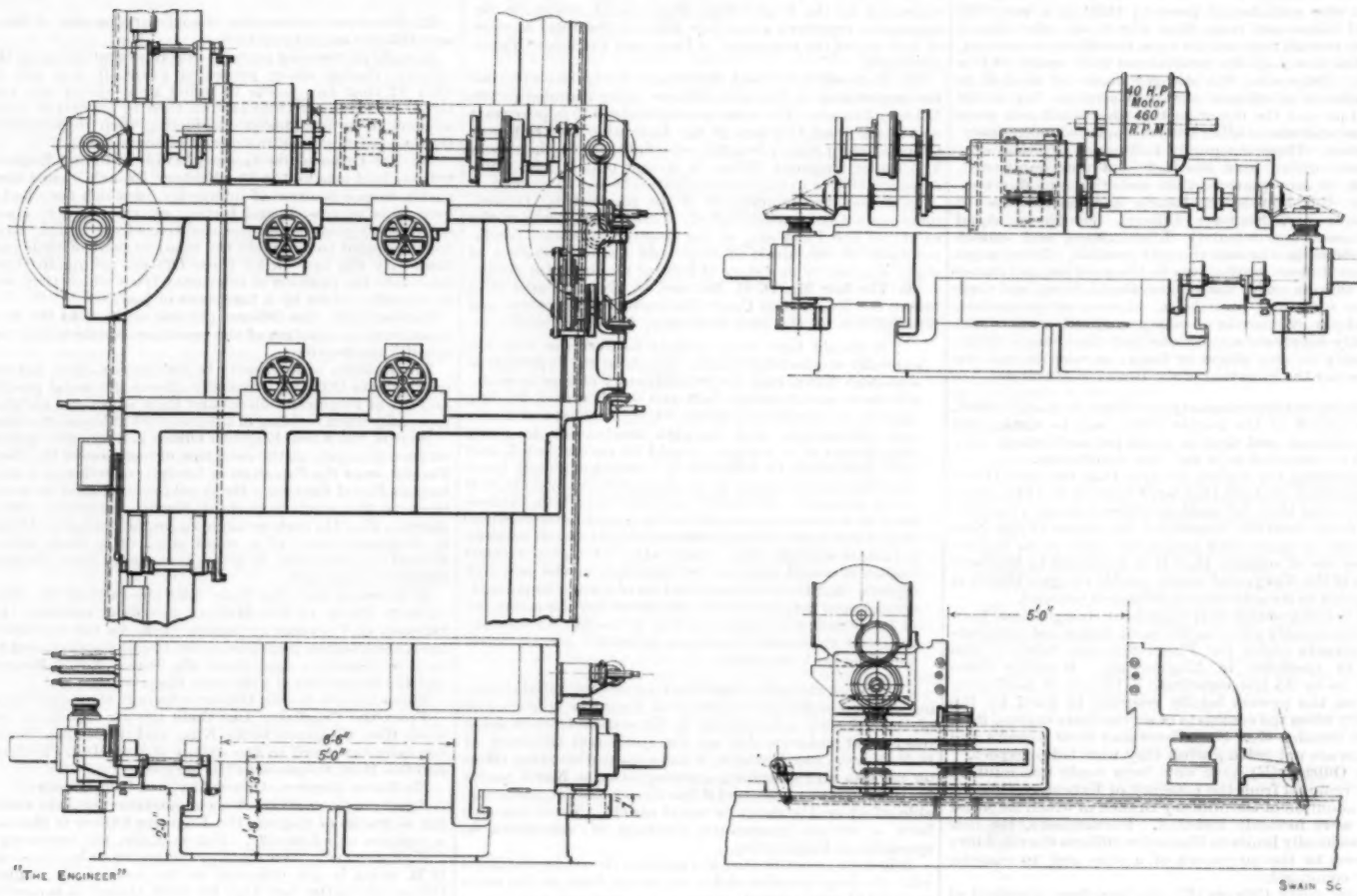
We, therefore, feel it incumbent on us, as being in a sense the Engineering Trustees of the Nation, to keep a watchful eye on all developments connected with engineering in His Majesty's Navy, and to make such constructive proposals as may be dictated from time to time by our special knowledge and experience.

21st January, 1926.

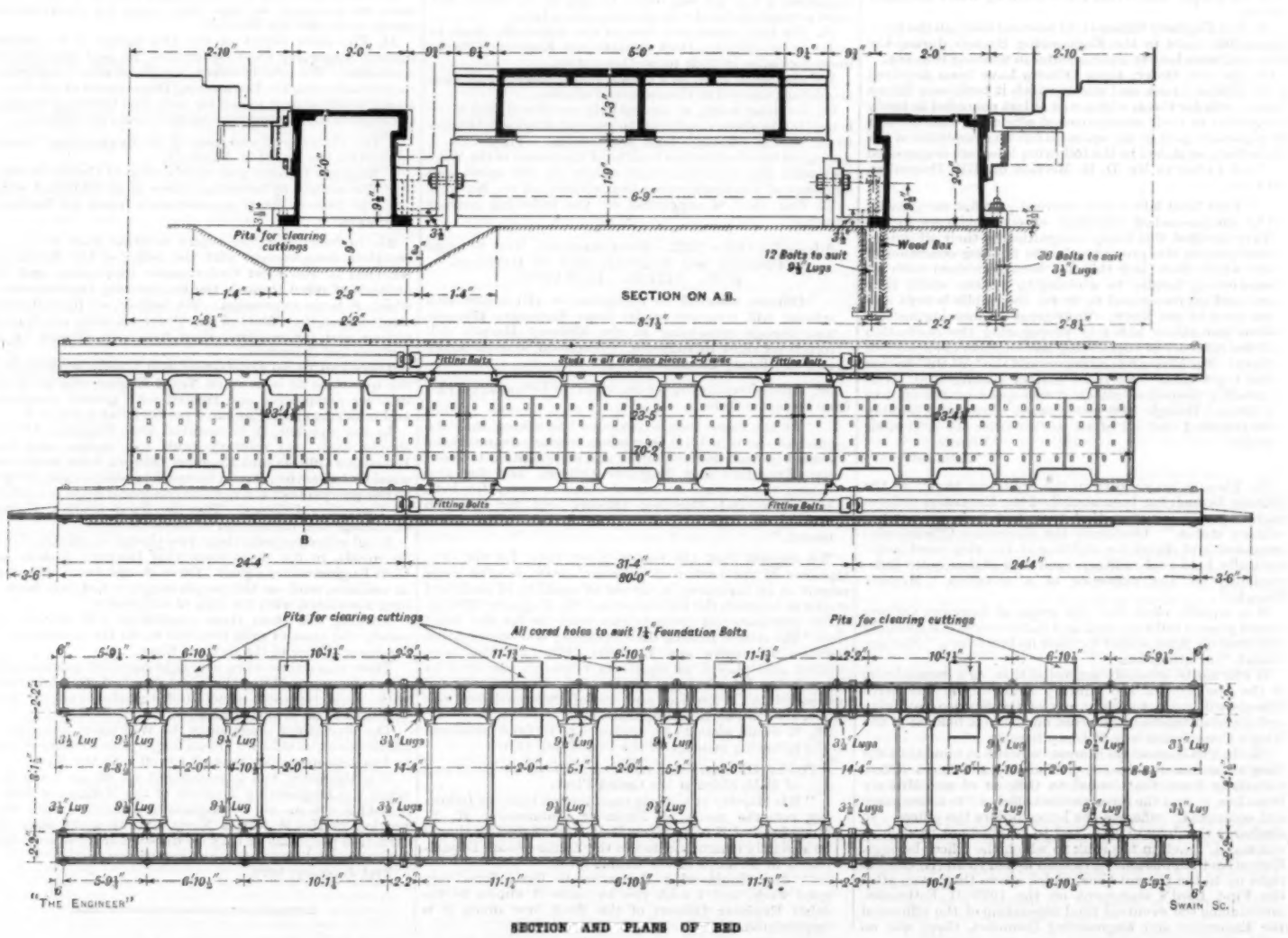
MACHINE FOR RIPPING STEEL PLATES

NOBLE AND LUND, LTD., FELLING-ON-TYNE, ENGINEERS

(*For description see opposite page*)



ARRANGEMENT OF TRAVELLING HEAD

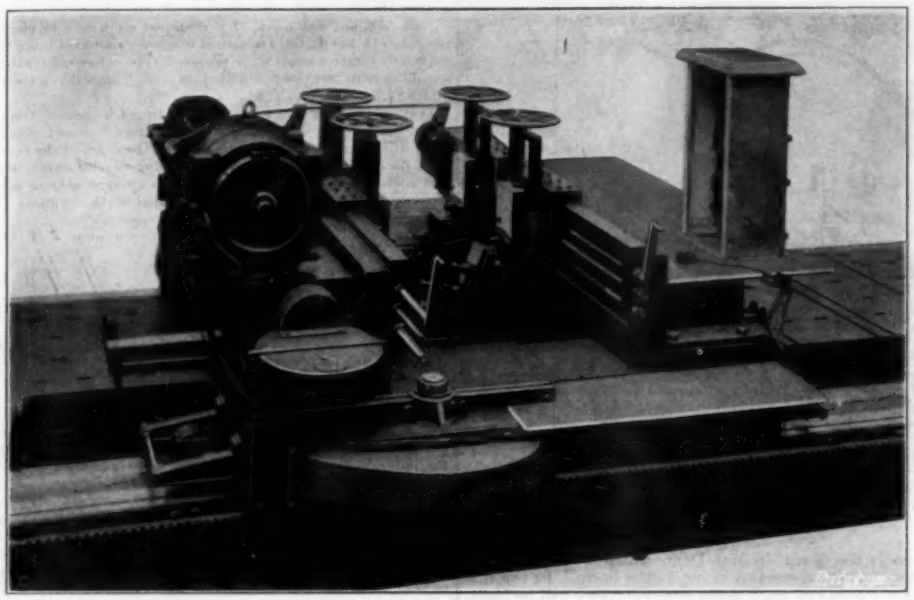


SECTION AND PLANS OF BED

A Large Plate Ripping Machine.

AT the Redcar works of Dorman, Long and Co., Ltd., the large ripping machine illustrated herewith and on page 326 has recently been installed by Noble and Lund, Ltd., of Felling-on-Tyne. The machine is employed for ripping up steel plates required for the construction of the Sydney Harbour Bridge on which Messrs. Dorman, Long are now engaged. It can accommodate plates up to 5ft. in width and 67ft. in length, and is capable of ripping them from end to end.

The machine consists of a long slide bed and table and a heavy travelling head. The plates to be ripped are clamped to the bed and the tools are set with a downward feed and to cut in both directions of motion of the head. Driving power is supplied by a 40 horse-power "Maxtorq" reversing motor controlled by a contactor panel. Motor and panel are mounted directly on the travelling head and operation is effected by means of push buttons. Current is



TRAVELLING HEAD OF PLATE RIPPING MACHINE

collected by means of a trolley from three wires stretched along the shop. From the motor power is transmitted to the travelling head through reduction gearing, the final drive being effected on to twin forged steel, machine cut racks fixed to the sides of the bed.

Four tool-boxes are provided on the travelling head, two of which act on the forward stroke and two on the reverse. They are arranged to work in pairs, so that two ripping cuts may be taken simultaneously. The tools are moved downwards into the plate by means of an automatic variable feed motion. A horizontal hand adjustment is provided to enable the tools to be moved into their desired positions across the plates. An automatic relieving motion lifts the tools clear of the plates during their non-cutting stroke. The reversing of the motion of the head is effected automatically and the length of stroke controlled by means of two adjustable dogs situated on the bed and designed to throw over a reversing switch. The bed has a total length of 80ft. and the machine a total weight of 100 tons.

FUEL TECHNOLOGY.

THE Council of the Society of Chemical Industry has placed before us certain proposals relating to the establishment of a Fuel Section within the Society.

For many years it has been the privilege and the function of the Society of Chemical Industry to provide platforms in all parts of the country for the discussion of the scientific and other aspects of fuel technology. A Committee, which was formed in 1924, undertook the organisation of meetings for this purpose.

The interest in fuel problems now awakened is indicated, among other things, by the proposed formation of a new Institution of Fuel Technology, which from its genesis appears likely to draw its membership largely from the engineering, electrical and commercial sides, but it is felt that industry in general will continue to look to the Society of Chemical Industry for the development on scientific lines of the principles and practice of fuel technology, which is more than anything else demanded for the better utilisation of the country's fuel resources.

It has therefore been decided that the existing Committee, which has already done such valuable work, shall be enlarged and placed in charge of a Fuel Section which shall be established within the Society and shall be devoted to the development of the application of scientific principles to the study of fuel technology. The Section will be open to any member of the Society who pays a registration fee of 5s. per annum, and the Committee, with its own chairman and secretary, has been appointed. The Section will take over the work of the Joint Committee of the Society and other bodies which organised the recent conferences at Leeds and Sheffield, and will do everything possible to strengthen the existing work of the Society in connection with fuel technology. This will be done principally by the organisation of adequate treatment of fuel subjects at the local sections; notices and wherever possible an advance copy of all papers upon such matters to be read before any section of the Society will be sent to members of the Fuel Section. The reports and "Transactions" of the Section will not be published separately, as in the case of the Chemical Engineering Group, but the Council of the Society will undertake that all papers upon fuel technology worthy of publication shall have adequate space allowed to them in the "Transactions" of the Society. Further, the abstracts relating to fuel technology will be materially extended.

It is felt that the formation of such a Section will co-ordinate the work of chemists and other workers engaged on fuel problems, and will secure widespread and effective discussion of that work. In order to prevent overlapping, and to enable the subject to be dealt with in as comprehensive a manner as possible, it is hoped that co-operation with other Institutions, by means of joint meetings, and in other ways may be arranged.

The members of the Committee are:—Professor W. A. Bone, Professor J. W. Cobb, Mr. E. V. Evans, Mr. G. S. Garland, Dr. Lander, Mr. McCulloch, Mr. W. J. U. Woolcock. The chairman of the Section is Professor Arthur Smithells, F.R.S., and the joint honorary secretaries are Dr. E. W. Smith and Mr. H. Talbot, to whom all communications should be addressed at Central House, Finsbury-square, E.C. 2.

Indian Railway Administration Report.

THE annual report for the year 1924–25 of the Indian Railway Administration opens with the remark that during the year trade showed a distinct revival, and the improved conditions throughout the country had a decided effect on the gross earnings of railways, which reached a figure higher than ever before recorded. The various administrations without exception have handled this additional traffic at a cost which represents a substantial lowering of the operating ratio.

The most notable event of the year was the acceptance by the Legislature of the scheme for the separation of railway finance from the general finances of the country. The new procedure has already resulted in a definite improvement in the railway outlook, and while the general revenues are now assured of a stable annual return from railways, the Railway Board is enabled to carry out a continuous policy of improvements based on the responsibility for obtaining a fixed dividend, coupled with an assurance of adequate funds for any operation which will secure such dividend. It has the further security that surpluses will be available for railway purposes, and particularly for building up reserves and a depreciation fund. Considerable progress was made with new construction, and, although only 233 miles of new railway were opened for traffic, at the close of the year there were 1201 miles under construction, representing a programme which, when completed, will result in an addition of some 2285 miles to the present system.

The opening of the first electrified railway in India—the new Harbour Branch of the Great Indian Peninsula Railway at Bombay—was another of the notable events of the year. This work is the precursor of the introduction of electric traction on a more extended scale, both for suburban traffic and for long-distance traffic.

The State took over the management of the East Indian Railway on the termination of the company's contract, with effect from January 1st, 1925. The contract of the Great Indian Peninsula Railway Company will terminate on June 30th, 1925.

In last year's report reference was made to some of the defects and weaknesses of the departmental system of administration and the introduction of the divisional system on the North-Western, Oudh and Rohilkund and East Indian railways was foreshadowed. During the year under review the Secretary of State sanctioned the reorganisation of the North-Western Railway on a divisional basis, and the new system was introduced on that railway with effect from October 1st, 1924. The East Indian and Oudh and Rohilkund railways have also been similarly reorganised with effect from February 20th, 1925. Steps are also being taken to introduce the divisional system on the Eastern Bengal Railway. Another important administrative change sanctioned by the Secretary of State during the year under review is the amalgamation of the East Indian and Oudh and Rohilkund railways, which it was hoped to effect from July 1st, 1925.

The Director of Mechanical Engineering with the Railway Board, who was shortly proceeding to England on leave, was deputed to study the question of locomotive manufacture in England, and to verify the conclusions arrived at by the Tariff Board, as stated in last year's report, of the number of locomotives which it would be necessary to construct in India in any one year to make the industry a success.

The question of railway connection between Burma and China has been much debated in the past, and there has been support for three possible routes. This question, however, is not one which can be examined at present. The connection between Burma and India presents very considerable difficulties; but a search is being made for what is known as "Sawbwa's route," a traditional way through the mountains of South Arracan, which has been abandoned and forgotten. There is also the possibility of a connection with Siam to be considered.

The electrification of the Bombay local lines of the B.B. and C.I. Railway from Church Gate to Borivli is being found necessary on account of the large and continuous increase of passenger traffic over these lines. Satisfactory progress was made during the year on this work, and it is hoped to open an electrified service on this portion of the line in the near future. Other schemes of electrification which are being considered are:—(1) The electrification of main line of the G.I.P. Railway to Igatpuri on the northern line and to Poona on the south-east line; (2) the electrification of the suburban lines in Calcutta; (3) the electrification of the suburban lines in Madras. Owing to the presence of a Ghat section on each of the main lines of the G.I.P. Railway, the introduction of electrification would result in a general acceleration of passenger traffic, in a considerable saving of time in the working of goods trains, and, as the ruling gradient on the Ghat sections is 1 in 37, in a reduction of working expenses, the present cost of working the traffic being very high. The acceleration of passenger trains between Bombay and Poona would undoubtedly help considerably in the expansion of this important town, as there would be a saving in time of about 1½ hours for mail trains between Bombay and Poona.

In the report for the last year it was mentioned that the subject of the standardisation of rolling stock continued to have the attention of the Railway Board during 1923–24, and that with regard to locomotives a permanent standing technical committee had been formed to consider the co-ordination of requirements in respect of existing and future types of locomotives, and to be the committee to which all suggestions for modifications and improvements are to be referred. Designs, as finally approved, will now be taken in hand, and as a result it is hoped that more suitable and efficient locomotives will be under trial on railways in India before the close of the year 1925–26, with a view to their final adoption as the new standard types. It was also mentioned in the report for 1923–24 that the Railway Board intended to appoint a separate technical committee to revise details of existing standard designs of carriage and wagon stock, and to prepare diagrams and general specifications for new types of wagons, and that the policy of continuous progressive standardisation adopted would be the same as in the case of locomotives. This committee was appointed in November, 1924, and its report, with recommendations, is expected to be ready three months after the close of the financial year under review.

The Railway Board awaits reports from the railways which are experimenting with transition devices for an automatic centre buffer coupler, and it is too early yet to say what the results of the experiments will be. Some of the coupler manufacturers are also concentrating on the design of suitable gear for use with the automatic coupler during the transition period, and it is hoped that a solution of what is perhaps the most difficult problem in the adoption of the automatic coupler will be arrived at shortly.

Revised rules for the purchase and supply of articles for the public service were issued by Government in May, 1924. The policy underlying these new rules is to encourage the industries of the country, so far as is consistent with economy and efficiency, with a more definite preference for stores produced and manufactured wholly or partly in India.

The giving of bounties, under the Steel Industry (Protection) Act, 1924, for the building of railway wagons in India has brought with it many difficulties, the recital of which fills three and a-half pages of the reports. The trouble, it may be said, began immediately after the above-mentioned Act was passed The report concludes as follows:—"it will be clear from the above explanations that the wording of the Act gives rise to considerable difficulties, and the question of the best way of avoiding them was under consideration at the end of the year."

RATING OF GENERATING PLANT.

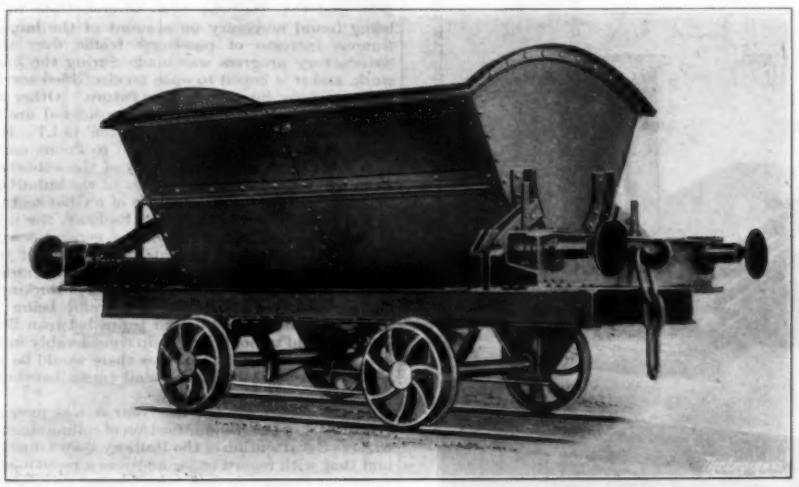
IN dealing with applications for their consent to the establishment of new or the extension of existing generating stations, the Electricity Commissioners have noted a growing tendency to provide for the installation of steam-turbo-alternators, designed for a continuous maximum rating and a service rating—most economical output—as defined in specification No. 225, 1925, published by the British Engineering Standards Association. The practice hitherto followed in submitting such applications has revealed a lack of uniformity, the capacity of the generating plant proposed to be installed being defined in some cases in terms of the most economical output and in other cases in terms of the continuous maximum rating.

With the view of obviating inconsistencies and of facilitating direct comparison of the plant capacities of different undertakings, the Commissioners have decided to adopt the continuous maximum rating when giving consent under Sec. 11 of the Electricity (Supply) Act, 1919, to the installation of steam-turbo-alternators of the kind in question. With regard to the statistical returns already issued by the Commissioners, the necessary adjustments will also be made in so far as any figures for plant capacity contained therein are included in future returns.

A New Type of Side-tipping Wagon.

A NEW type of large-capacity side-tipping wagons has recently been introduced by Robert Hudson, Ltd., of Gildersome Foundry, and 38A, Bond-street, Leeds. The makers claim that by the use of this new type of wagon a considerable saving, both in time and expense, may be effected when large quantities of materials have to be dealt with, since a whole train of wagons can be unloaded in a very few minutes. The accompanying illustration represents a wagon having a capacity of 200 cubic feet, and we understand that wagons of this type, with capacities up to 300 cubic feet, are also being made.

The special feature of this wagon is that it automatically discharges its contents on the release of a catch, and the body remains in its discharged position until another catch is released, when it automatically returns to its upright position ready for refilling. There are but few working parts, and what there are are of such robust



200 CUBIC FEET SIDE-TIPPING WAGON

character that the chances of breakdown are reduced to a minimum.

The wagon is built for a 4ft. 8½in. rail gauge and is arranged for buffing and coupling with main line rolling stock. In the illustration it is shown with cast steel wheels, but steel-tired wheels and any type of brake gear can be fitted if desired.

SIXTY YEARS AGO.

BEFORE the year 1851 tubes had been made cold from steel but only as curiosities. The process employed consisted of beating up a cup from a circular steel disc and driving this cup once or twice through a die. The tubes so produced were of short length and very expensive. The idea of developing the process on a commercial basis occurred, it seems, in the year mentioned to Mr. G. P. Harding and Mons. L. Cristophe, who, while working in Paris, were attracted by the remarkable softness, toughness and ductility of a very peculiar steel made by Mr. Hawksworth, of Linlithgow. This steel had been evolved after many years of labour, and was specially intended for use in the manufacture of the rolls of calico printing machines. These rolls were produced by causing them to revolve under great pressure against a very hard steel roller on which the required pattern had been engraved. At a later date cold-drawn tubes could be made from any good steel but without Mr. Hawksworth's material it would probably have been impossible to overcome the early difficulties and disappointments which Messrs. Harding and Cristophe experienced. By 1864, in which year we first drew our readers' attention to the process, sufficient progress had been made with the idea to show that it provided a good opening for the investment of capital. Temporary premises were taken in Willow Walk, Bermondsey, where machinery was installed. Messrs. Harding, Hawksworth and Cristophe were now working in close conjunction with each other, but their system was still crude. By 1866, however, it had been so far developed that an influential company had been formed to exploit it—the Cold Drawn Steel Tube and Ordnance Company, Ltd.—new premises had been taken in Macclesfield-street, City-road, London, and the manufacture of cold drawn steel tubes on a commercial basis and on a large scale had become possible. In our issue of March 16th, 1866, we gave remarkably full details of the process employed and illustrations of the machinery used. The process described does not differ materially, we believe, from that still in use. It consisted of drilling an ingot through its length and drawing it hydraulically through dies over a mandril. Of the difficulties encountered in the way of making the process a commercial success, one of the chief consisted in drilling the ingots in a rapid and economical manner. Eventually a machine, which we illustrated and described, was produced, which was capable of drilling ten ingots simultaneously from both ends. Another difficulty consisted in devising a sound method of holding the ingot end while the tube was being drawn. Various means were employed, one of the earliest, abandoned on account of its expense, consisting of a screw tapped into the end of the ingot. A form of friction grip and a collar on the end of the ingot were eventually adopted as alternatives. The process was at the time of our description being successfully applied to the cold-drawing of tapered gun barrels by means of a device which caused the dies to close progressively inwards as the drawing proceeded.

NEW HYDRAULIC WORKS IN SAO PAULO.

A COMPREHENSIVE scheme of hydro-electric development is about to be undertaken in the State of São Paulo in connection with a concession granted to the English company, the São Paulo Tramway, Light and Power Company, Ltd., by the President of the State. In view of the frequent failure of power during the long dry seasons, it has long been considered necessary to add to the company's production, and, to carry this out, certain indispensable privileges and rights, hitherto withheld, have now been granted. The company is authorised to construct dams for the retention of the surplus water of several rivers, which in the summer run to waste. These streams will be connected by canals, tunnels or conduits, and thence led to the reservoirs. It is intended to adapt the water courses to serve as water highways, and the company has been granted the exclusive right to carry over them passengers and goods. The first installation to be undertaken is the Serra do Mar Dam, which will receive the waters of fifteen streams rising in the Serra. In the district a number of small dams and reservoirs will be built, connecting with one large reservoir at the head of the Serra. Thence the waters will be diverted from their natural course inland, discharging themselves towards the sea by tunnels through the mountains and producing on their way an artificial waterfall of over 2000ft in height. The turbines, with a total capacity, when completed, of 300,000 horse-power, will be installed at the foot of the Serra. This power will probably satisfy demand for several years, but provision will be made for any necessary extension of the supply.

Work is proceeding so satisfactorily at the Serra do Mar section that it is hoped before the end of this year to provide 40,000 horse-power. The drawing off of the superfluous water from the numerous streams will prove of great value in times of flood, since it will obviate inundation of the low-lying parts of the city of São Paulo and the swamping of the valleys of Pinheiros and Tamanduatehy, which seasonal occurrences have caused much damage in times past.

Letters to the Editor.

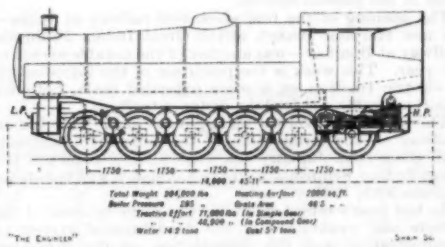
(We do not hold ourselves responsible for the opinions of our correspondents.)

LOCOMOTIVE DESIGN.

SIR,—With respect to the further development of the steam locomotive, I should like to make the following suggestions:—

(1) Maintaining the point of view that in buying a locomotive we try to "acquire the maximum tractive effort available from an engine of a given total weight," we must eliminate, as far as possible, every deadweight decreasing the adhesive efficiency of the locomotive as a unit. The construction of tank locomotives, therefore, with up to 100 per cent. of the total weight resting upon the driving axles, will be preferable.

(2) From the point of view of an increased thermal efficiency



higher steam pressures and temperatures and compounding must be employed and simple means devised to get an intermediate reheating of the working fluid.

(3) The steam engines must be of the high-speed type and conveniently geared to the driving axles so as to eliminate the present wide variations in the torque transmitted to the driving axles.

(4) The driving axles must have radial adjustment and side play in order to insure easy curve-riding, &c.

A locomotive designed along these principles and intended for the work on British railways, is shown in the accompanying sketch, and may be briefly described as follows:—

The fire-tube boiler is designed for 395 lb. per square inch pressure, and is provided with a particular type of high efficiency water-tube fire-box. The highly superheated steam leaves the boiler through the smoke-box and is carried towards the high-pressure engine situated at the rear end of the locomotive. The high-pressure steam piping is carried within the intermediate pressure piping so that an efficient reheating of the working fluid by the live steam is obtained. Both the high and the low-pressure engines are of the three-cylinder high-speed type and are located between the frames, and yet are very easily accessible. One of them is geared to the leading and the other to the trailing pair of driving axles. The other drivers are suitably geared to both pairs of drivers.

The water tanks are of the orthodox side-tank type, and the fuel tanks are located at the rear end of the locomotive.

Beside the big advantages of increased fuel economy, high adhesive efficiency, &c., we must keep in mind that such tank locomotives are easily double-end operated and consequently require less labour in their terminals, &c. Moreover, they would be cheaper in first cost than is an orthodox type locomotive of having the same maximum tractive effort.

And last, but not least, why shall we employ a locomotive of some 414,500 lb. total weight if it is not capable of more than 46,630 lb. tractive effort if the proposed type of locomotive, when weighing only 264,000 lb., will exert over 71,000 lb. of tractive effort?

Certain constructors when pressed to get increased tractive effort out of their engines, install "boosters" geared either to the trailing axle of the locomotive or to the axles of the tender. This proceeding, I believe, is a wasteful capital expenditure, and such constructional complications represent also an aggregate deadweight during, say, nine-tenths of the running time of the locomotive when the "booster" remains idle.

CHARLES J. TOTH.

Montevideo (S.A.), February 15th.

TRAINING OF ENGINEERS.

SIR,—The direction in which the correspondence on this subject is tending leads me to suggest that secondary school education in this country is too predominately literary in type. The underlying principle, that early specialisation is harmful, is sound; but, in practice, the special instincts of man as the tool-using animal are starved at an age when their satisfaction would have the strongest effect on the mental development of the individual. The harmful results operate against engineers in two ways:—

(1) As the attention is directed too closely to books and pencil, the individual comes to lack the power to visualise a mechanical problem as a whole. I find it difficult to express my meaning clearly as well as concisely, but perhaps I shall not be misunderstood if I say that it is important to be able to think concretely as well as in the abstract. That sense which enables a good mechanic to know, as if by instinct, in what direction the solution of a problem is to be sought, is developed, if ever, at an early age. Many boys oppose this stultifying influence of their school training to such a good effect that we have frequent examples of boys who were the despair of their schoolmasters doing excellently later on in life.

(2) Having passed the first school examination (the school certificate, matriculation and the like) and gained freedom to specialise, the budding engineer gladly puts away the childish things, which he regards as obstacles imposed on him by his stupid elders, and concentrates on his professional studies, to the exclusion of all else. Had he been allowed to exercise his bent earlier, he might have learnt to regard literary studies as a welcome adjunct and relief; and in later life he would turn to them for mental recreation.

I plead, on the one hand, for more manual work in our schools, and, on the other, for more humanistic training at a later stage for those who adopt the engineering profession.

Harrow School, March 14th. C. L. BRYANT.

THE CONSISTENCY OF STEAM TABLES.

SIR,—In your article under the above heading in your issue of March 5th, it is stated that "It would be an advantage to English engineers if someone would publish an equally attractive Mollier diagram based on Callendar's tables, &c."

I write to say that we have in the press, and it is hoped to publish in the course of a few weeks, an enlarged Mollier diagram for saturated and superheated steam, plotted by Professor H. L. Callendar, F.R.S., from his enlarged steam tables. This diagram covers temperatures up to 1000 deg. Fah. and pressures up to 2000 lb. per square inch, and includes volume and superheat lines. It is printed in three colours on unshrinkable paper, and will be published for us by Messrs. Edward Arnold and Co.

I would also draw your attention to the enlarged heat drop tables, calculated by Mr. H. Moss, D.Sc., A.R.C.S., D.I.C., from the formulæ and enlarged steam tables of Professor Callendar, and recently published for us by Messrs. Arnold and Co. The adiabatic heat drop of 1 lb. of steam is herein tabulated in B.Th.U. for initially dry, saturated or superheated steam of pressures 400 lb. to 2000 lb. per square inch gauge. The final pressure range has also been extended, and is from 27·0in. to 29·5in. of mercury vacuum, corresponding to absolute final pressure of 3·0in. to 0·5in. of mercury.

E. B. WEDMORE,
Director and Secretary,
B.E.A.I.R.A.

London, March 17th.

AN INSTITUTION OF FUEL TECHNOLOGY.

SIR,—Will you permit me to remove a misconception which has inadvertently occurred in the account of the meeting of March 5th; the reference appears on page 285 of the current issue of THE ENGINEER, under the above heading.

On that occasion I was not a spokesman of the "Nottingham body" in the light of a supporter of the amendment proposed by Mr. Pope. That amendment first came to my knowledge when Mr. Pope introduced it at the meeting. The chairman was requested to put "the amendment and get it out of the way." It was at that juncture that I intervened as an individual member of the Council, and in what I considered to be the best interests of the Institution of Fuel Economy Engineers. The amendment was withdrawn. LEONARD HARVEY,

London, March 12th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

BUSINESS in iron and steel has been very quiet in the Midlands and Staffordshire this week, the labour unrest being chiefly responsible. Both producers and consumers are inclined to put off business until the outlook is clearer, especially in regard to engineering, this labour difficulty being more threatening to the iron and steel trades than the coal position. Buyers and sellers of iron and steel are showing the utmost caution, the former purchasing for immediate needs, and the disposition is general not to enter into long-date forward commitments. A peculiar exception is an improved buying of forge pig iron, several contracts having been reported, running into hundreds of tons. This branch of the market has been stagnant so long that the business is very welcome, and hopes are entertained of increased activity in the near future.

Raw Iron Prices.

Midland raw iron values continue to fluctuate. A week ago they gained strength after a slight fall, but this week values sagged again to the level at which they stood a fortnight ago. It is only in the foundry branch that values have changed for until a fortnight ago forge values were indeterminate, and it was only on the opening up of demand in this material that quotations took definite shape. Northamptonshire forge now commands £2 17s. and Derbyshire £3 2s. to £3 3s. Northamptonshire No. 3 foundry is down to £3 3s., with some makers holding out for £3 4s. 6d., while Derbyshire ranges from £3 6s. to £3 7s. Caution is the ruling factor at the moment, however, and those producers who asked the lower rates apparently added little to their order books. There seems to be a complete lack of enterprise on the part both of producers and consumers, and, if anything, last week's market quietude was accentuated on 'Change to-day—Thursday. Indecision which had been previously apparent only in isolated cases was more pronounced. The business done in Midland pig irons was for the most part in forge material, which experienced a flicker of activity. Some buyers were reported to have purchased forge pig iron running into hundreds of tons. This for a long time has been a stagnant department, and the buying is interpreted as showing a certain amount of confidence by Staffordshire ironmasters in regard to future expansion. Many merchants at to-day's meeting were of opinion that prices would recede further, and they wanted larger concessions than Midland smelters were prepared at the moment to make.

Steel.

There has been only a moderate call for steel this week. It is reported that there is a falling off in the inquiries for constructional work, mainly attributed to the difficulty with the engineers. Many steel works have very fair orders on hand, but producers complain of the unremunerative prices. Midland rolling stock builders continue busy, and the favourable reports lately issued by local companies present an agreeable contrast to those of the steel companies. Works in the Black Country still find these builders of railway wagons useful customers. The decided improvement in shipbuilding has raised hopes of orders for ship plates, though they have not yet materialised, and the plate mills generally are very short of work. Steel values remain irregular. Small steel bars are quoted at £7 15s. to £7 17s. 6d., the market having definitely slackened. The Belgian price is about £6 10s. The irregularity of prices for structural steel is emphasised. Some cutting is reported on the part of unassociated mills in the hoop trade, but the official price remains £10 10s. at works. Angles and joists range from £7 to £7 5s., tees from £8 to £8 5s., ship bridge and tank plates from £7 15s. to £8, and boiler plates from £11 to £11 10s., delivered in the district. A little improvement in tinplates has increased the demand for sheet bars, a development very useful to the steel works. Fairly large quantities of steel scrap are being bought on the basis of £3 7s. 6d. delivered South Wales. Mild steel wire has been reduced 1s. per cwt. Foreign competition is chiefly for finished material. Continental sellers are not keen for British business in semi-finished steel, and a number of British offers below the £5 7s. 6d. figure for Belgian billets have been refused. The continental makers find it more profitable to sell finished material at prices which, when the shipment from Antwerp is added, still leave a margin of about £1 below British figures. There is no sign of falling off in imported tonnage of finished material, and Germany has been much more prominent in this direction during the last few weeks, in some cases quoting a few shillings below Belgian quotations.

Staffordshire Iron Trade.

The Staffordshire iron trade shows a little improvement, chiefly as the result of more liberal railway buying. The increased buying of forge iron indicates a certain amount of confidence in the future of the Staffordshire finished iron industry, but although ironworks show a little more activity, nothing substantial has developed. The general steadiness of pig iron prices has probably led to the conclusion that nothing is to be gained by waiting, and the difficulty of disposing of this class of material has, doubtlessly, encouraged sellers to waive in this case their policy of avoiding heavy future commitments in the present labour uncertainty. Local ironworks are badly in need of business, particularly in medium and common qualities. Prices continue weak, and it is reported that the recent "cuts" made by some mills have made it extremely difficult to obtain new business. Crown quality iron is quoted at £11 5s. per ton and marked bars at £14. The amount of business in the latter is not maintained, and some of the mills have difficulty in keeping up regular working hours. The big price difference between Belgian No. 3 bars and Staffordshire nut and bolt quality iron is so great that much of the business available is being sent to the Continent. Plenty of Belgian iron is now on offer at £6 15s., against the local figure of £10 5s. or thereabouts. The Charleroi makers offer to deliver this material within a fortnight from the receipt of the order.

Sheet Values.

Galvanised sheets continue to show improvement, recent bookings being increasingly for May delivery. The price of £16 to £16 5s. for 24 gauge corrugated sheets is not fully maintained, some mills being prepared to shade prices where substantial export orders are at stake. Better orders are coming from South America and the Far East.

The Production Figures.

The recent statistics of output of iron and steel for the month of February have been carefully scanned by Midland industrialists, many of whom profess to gather therefrom that business is at last mending, if ever so slowly. On the raw iron side, the figures show that allowing for the shorter month, the rate of production in February was somewhat higher than in January, the daily rate amounting to 17,929 tons, compared with 17,209 tons in the preceding month. The total production of pig iron in February amounted to 502,000 tons, compared with 533,500 tons in January, and 541,900 tons in February, 1925. The output included 157,300 tons of hematite, 175,200 tons of basic, 123,100 tons of foundry, and 22,400 tons of forge pig. It is noted that there was a net increase on the month of two in the number of furnaces in blast throughout the kingdom, three furnaces having been put into blast and one blown out, making at the end of the month 146 furnaces at work. It is regretted that no additional furnaces have been put into operation in this district.

The Coal Commission.

Impressions of the Coal Commission's report in the Midland coalfields are neither particularly unfavourable nor yet enthusiastic. The mineowners on Cannock Chase and in the Black Country consider that the Commissioners' suggestions will bring no easement of the present situation. Many regard the stoppage of the subsidy as a mistake, while the present state of affairs persists. One colliery manager described the suggested withdrawal of the State grant as "disastrous" for the weaker mines. Mr. H. W. Hughes, treasurer of the South Staffordshire Mining Association, expressed the view that no practical benefit would accrue from the State ownership of the mineral. There is, however, no great feeling with regard to the subsidy. The eastern area—which includes Cannock Chase—has, it is claimed, come nearer to the point of being able to do without the subsidy altogether since that device was instituted than any other coalfield. Nationalisation has never been a burning question in this area, and the prospect of reverting to district agreements does not seem to cause undue alarm. So far as the men are concerned, they are inclined to set aside for the moment the consideration of the questions of nationalisation, reorganisation and the acquisition of the mining royalties, and to concentrate attention upon the recommendation of the Commissioners with regard to the reduction of wages. It is around this matter that controversy will centre. It is practically certain that the proposed reduction of the 1924 percentages on standard rates, involving a decrease in real wages, will be strenuously opposed by miners in this district. It is generally agreed that if the two sides concerned met each other, prepared to discuss matters in a conciliatory way and to give and take a little, a great amount of good ought to arise from the Commission's investigations and report.

The Coal, Iron and Steel Trades.

The President, Mr. A. E. Bond, at the forty-sixth annual general meeting of the Birmingham Exchange last week, stated that a remarkable feature of the general trade position seemed to be that coal, iron and steel were dragging behind the other industries, and giving the whole trade of the country a much worse appearance than it would have otherwise. Practically they were the only really unsound trades in the country, for the others seemed to be recovering to some extent from the depression. The large decreases during the past year in the production and export of iron and steel, accompanied by the substantial increase in imports of foreign material, were responsible to a considerable extent for a great deal of the unemployment in this country.

Ironmaster's Retirement.

After being actively associated with the iron and steel trades for seventy-three years, Mr. W. Wesson, chairman of W. Wesson and Co., Ltd., Moxley, is retiring. The good feeling prevailing between masters and men at the works was commented on at a complimentary dinner on Saturday last, when a presentation was made to Mr. W. Wesson of a gold watch and an illuminated address, subscribed by employees. Mr. W. Wesson, who is nearing eighty-two, started work when seven. In 1898 he founded the business of W. Wesson and Co., Victoria Iron and Steel Works, at Moxley, now carried on by his sons.

Unemployment.

There is a decrease of 3267 in the number of totally unemployed in the Midlands, as recorded in the current return, and a decrease of 6533 over the figure given a fortnight ago. The present total of 114,787 compares with 118,054 recorded last week. There is, further, a decrease of 2235 in the number on short time. In the Birmingham area there are on the live register 21,906 and on short time or off work temporarily 2144; while at Coventry the figures are respectively 1261 and 235.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE iron and steel markets in Lancashire throughout the week have naturally continued to be under the influence, to a very important degree, of the possibility of a stoppage in the engineering industries. The extension of the lock-out notices until Thursday of this week, and the later developments regarding the unions themselves, raised hopes that a stoppage would be avoided, but although the tone of the markets was less depressing than it has been for some time, the spirit of hopefulness did not resolve itself into an increase in the volume of business transacted. Whilst the uncertainty existed it could hardly, perhaps, be otherwise. Fresh inquiry and actual new business have alike been restricted, and judging from the experience of many iron and steel firms here one is justified in reaching the conclusion that most buyers have been exercising a good deal of caution in keeping purchases down to a bare minimum and reserving their orders, relatively small as they must be under present conditions, until the outlook became clearer. The view has been expressed that this accumulation of business, whatever its volume in the aggregate, will result in something in the nature of a spurt when the markets settle down again. The substance of the Coal Commission's report was not, on the whole, contrary to expectations, but the attitude of the Lancashire iron and steel trades, after a sufficient interval had elapsed for the contents of the report to be partially assimilated, was generally non-committal.

Non-ferrous Metals.

The position of the non-ferrous metals remains pretty much the same as it has been during the past month or so, any modification that has taken place being, if anything, towards more sluggish conditions and in this, of course, the general outlook has played its part. Tin has continued to display a very firm tendency, and the strength of the position of this metal is fully recognised on this market. For all that, however, the demand in this area continues quiet, and consumers have certainly shown little anxiety to enter the market except to the extent of filling immediate needs. In copper, also, the demand has been of a quiet character, and buying operations have been very limited. A moderate business has been reported in some lines of manufactured copper but, of course, it has been a long way from normal The net result of the variations in the price of the metal has not so far been to affect the quotations for copper sheets and tubes. Comparatively little business has been done in lead during the week, much less probably than the state of the cable-making industry and of other lead-using industries would lead one to expect. Spelter, likewise is attracting only moderate buying interest, although it is expected that galvanisers before very long will have to begin buying again on a larger scale than they have been doing recently.

Iron.

Although the placing of new contracts for pig iron has been seriously interfered with by the engineering trade trouble, the threatened lock-out, so far as one could learn by careful inquiry, had not resulted in the suspension of any deliveries under existing contracts. It was recognised, however, that it would inevitably follow a general closing down of works. No secret was made of the fact that certain orders were definitely hanging fire pending a settlement. Producers of pig iron, however, in most cases are busily engaged to the extent of the capacity of the plant that is in commission on orders placed several months ago, and until recently had not been actively seeking fresh business. Many of them, I understand, are now booked up for at least a further two months. Prices are steady all round in this section, with Lincolnshire and Staffordshire No. 3 foundry pig at 76s. to 77s.; Derbyshire at 75s. to 76s.; Scotch iron at 94s.; and West Coast hematite also at about 94s.; these prices including delivery in the Manchester district in all cases. A small inquiry is reported for bar iron, but the demand is still quiet. Values, however, are steady at £11 5s. to £11 10s. per ton for Lancashire Crown bars, and at about £10 5s. per ton for seconds, delivered in the Lancashire area.

Steel.

The current demand for steel appears to be very quiet in most sections of this market. In some respects values are distinctly easy. In the absence of any important business to test them current quotations may be regarded as more or less nominal, for competition for any passing orders is so keen that it is not unlikely that lower prices would be accepted, especially if the orders were of a decent size. I understand that one firm in this area has succeeded in getting a fairly good order for constructional material within the last week, whilst in connection with the London, Midland, and Scottish locomotive contracts placed in Lancashire I am told that one of the firms concerned has sent a substantial order for boiler-plates to Scotland. Joists and sections are still quoted here at £7 2s. 6d. per ton delivered, plates at £7 12s. 6d. to £7 15s., and steel bars at £7 17s. 6d. to £8 5s. These prices are nominally unchanged from those last reported. Deliveries of continental steel material under existing contracts have been interfered with to some extent by delays at ports on the Continent. It is this delivery factor that plays an important part in the volume of buying of foreign steels, for there is no denying that the prices now being quoted are tempting enough. Competition between sellers of this continental material is very keen indeed, but at the moment, at all events, buyers are not ordering much of it. Sheet bars are now offered at £5 7s. to £5 8s. 6d., joists and angles at £5 15s. to £5 17s. 6d., steel bars at £6 5s., and Siemens' plates at £6 15s., delivered here. In British galvanised sheets demand is quiet just now, with values easy at £15 15s. per ton, f.o.b., for Indian specifications.

Scrap.

The demand is rather quiet for both iron and steel and non-ferrous metal scrap. Mild steel is quoted at about 55s. per ton on truck, Manchester, and wrought iron at 70s., ordinary machinery cast iron at 70s., and textile machinery scrap at 72s. 6d. to 75s., all delivered. Light copper scrap is £51 to £52, heavy copper scrap £61, gunmetal £52 to £53, zinc, £24 to £25; lead, £32; cast aluminium, £92; and brass rod turnings, £40 for graded and sorted materials delivered.

The Engineers' Club, Manchester.

The annual report of the Committee of this Club for last year which has just been circulated, shows a very healthy state of affairs. The membership is 753—a slight decrease compared with the previous year, but this will probably be remedied when it is known that there is now no waiting list, and that the premises have been enlarged. At the annual meeting on March 30th next it will be proposed that sons of present members, with the necessary technical and social qualifications, shall be eligible for membership at the age of twenty-two, instead of twenty-five as hitherto. The report states that although the club rooms have always been available for meetings of technical societies connected with engineering and the allied industries, it was not possible to extend the Club's hospitality to as many institutions as was desirable until the enlargements were completed. In the past the periodical meetings of the Institutions of Mechanical and Electrical Engineers and the Manchester Association of Engineers, have been held in the "Joule" room. Arrangements have been now effected with several of the junior societies to hold their meetings in the Club premises in the future, thus furthering the original idea of the promoters that the Club should be the pivot of the engineering industry in this district.

An Engineering Amalgamation Scheme.

At a meeting of the shareholders in the local firm of Mirrlees, Bickerton and Day, Ltd., held in Manchester on Wednesday last, 17th inst., unanimous approval was given to a resolution authorising the directors to enter into an agreement with the Mirrlees, Watson Company, Ltd., Glasgow, for an amalgamation of the two companies.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade of the North-West Coast shows no sign of expansion whatever, and it will be a month or two before it will be possible to say which way the market will go. Caution is exercised by buyers at present, and they are only taking sufficient quantities of iron to keep themselves going. In one or two cases there are orders for forward delivery extending a few months, but most consumers are satisfied to work practically from hand to mouth. The Midlands provide the best customers. Scotch buyers are not keen at present, the amount going over the border being only moderate. The present output from twelve furnaces is now being practically absorbed, but it must be remembered that the local steel departments are taking a fair amount of the production. If the steel trade were to slump, and the mills stop, there would be an overmake and either stocks would increase or there would have to be damping down. The continental trade is very quiet, and there is not the same demand from America for special qualities as there was although some trade still exists.

Iron Ore.

The iron ore trade depends mostly on local requirements, and as the latter are not heavy, there is not much activity amongst local mines; in fact, some are practically idle. The amount going out of the district is negligible. Foreign ore is being imported from Spain, Norway, &c., in restricted quantities.

Steel.

The steel trade is only moderate, and fresh orders would be welcome. There are a few orders in the market, but there is keen competition for them. At Workington there are not sufficient orders to create a full month's working, and thus the mills are idle part of the time. At Barrow the rail mills are still working, but fresh orders are needed. The hoop and small section mills are better situated for orders.

Shipbuilding.

On Tuesday the cruiser Cumberland was successfully launched from Vickers Naval Construction works. Like the others of the "County" class, she will have a tonnage approximating 10,000, and it is said will have a speed of about 35 knots. She will carry 8in. guns fore and aft, and also a number of smaller guns, some of which will be anti-aircraft.

SHEFFIELD.

(From our own Correspondent.)

Position of Heavy Steel Trade.

FEARS as to what will happen in the engineering industry have had a further retarding influence on forward buying, and those with business to place have backed out to await developments. So little confidence is felt in trade in these days that even threats of disputes have a surprisingly far-reaching effect. On orders in course of execution there has been a considerable speeding up of work. Generally, the position of the steel trade remains about the same. Billet and semi-steel makers, by making sacrifices in their quotations, have been able to secure work for which continental firms were competing. In one sense this is satisfactory, but it is pretty certain that the orders will not result in a penny of profit. There has been no further decline in the number of open-hearth furnaces in commission. The disparity between recent Sheffield and recent continental steel prices has been less wide of late, but it threatens to increase again, the latest reports being that continental prices are inclined to fall. There is now a good output of railway steel, as a result of the orders for railway material, which have come into the district during the past few months, and which I have noted from time to time. The British railway companies have been ordering on a fairly liberal scale, and it is stated that these orders are proving insufficient, and that additional contracts will have to be placed. Wire makers are working at a fairly steady, though not full rate, the main source of activity being material of the better quality. In common wire there is considerable continental competition.

Engineering Orders.

It is reported by Vickers Ltd. that the Osaka Mercantile Steamship Company has ordered two vessels of 1500 tons gross register to be constructed at a Kobe shipyard, and that each of these vessels is to be equipped with two sets of Vickers 600 horse-power Diesel engines. Steel rail mills in the Sheffield district are interested in an inquiry for 15,384 tons of rails, together with fish plates, for the Madras and Southern Mahratta Railway. This is part of a series of inquiries resulting from an intensive scheme of railway construction and replacements to be carried out in India this year. May, June and July are the months fixed for the delivery of the rails. Last week I referred to the placing of a contract for 2000 coal wagons, and the official announcement with respect to this order has now been published. The order has been placed with Charles Roberts and Co., rolling stock manufacturers, of Horbury Junction, near Wakefield, by the proprietors of Llay Main Collieries, Gresford, North Wales, and Carlton Main Collieries, Barnsley. As I stated last week, the estimated value of this contract is about £250,000.

Tool Trades.

The tool trades are still passing through a period of slight depression. Last month the exports of files, saws and edge tools numbered about 2,000,000 articles, which was a slight increase on the figures for January, and was equal to the average for the last two years. The position of spades and shovels was also maintained, and engineers' small tools were better on the month by 5000. Imports of implements and tools fell from £91,000 in January to £85,412 in February. Orders from abroad are not coming through as fast as could be wished, but the buying season for files, saws and edge tools should shortly recommence in full force. Makers of garden and farm implements have full order books, and it is stated that wholesale and retail houses are lightly placed as regards stocks left over.

Cutlery and Plate.

The condition of the cutlery and plate trades is causing the greatest anxiety. Most of the old-established houses have been losing money for several years, and there is not the slightest sign of an improvement in trade, many people are wondering how much longer these firms can carry on under such conditions. There was a falling off in the exports of cutlery last month, as in January, and the state of the inland market is forcing prices down to a profitless point. The announcement has just been made by one of the biggest and oldest houses of a reduction of 12½ per cent. on all stainless cutlery. Admiralty tenders are out for 3480 table knives, 2760 dessert knives and 228 carving knives, all with electro-plated handles; 864 ivory-handled knives; 1000 cooks' knives; 1460 carving knives; 1260 carving forks; 1080 steels; 607 plated dinner knives; and 252 bread knives. The Cutlery Safeguarding Duty has now been in operation nearly three months, and to a certain degree it is possible to gauge its influence. At the time the duty was imposed it was felt that the difference between the prices of the Sheffield and German-made article would not be bridged by a duty of 33⅓ per cent., the difference, in fact, being greater than this. The duty, however, has already had a beneficial effect, for several manufacturers report the receipt of orders which they are able to attribute definitely to the effect of the duty. The pen and pocket knife trades have been in a bad way for several years, and it has now been possible actually to increase employment.

Colliery's Serious Position.

Since my reference last week to the position of the Hatfield Main Colliery, near Doncaster, the annual meeting of the shareholders has been held. The chairman, Mr. J. P. Houfton, made a frank statement of affairs, without attempting in any way to belittle the seriousness of the position. The debit of profit and loss account has increased from £142,445 to £235,929, and the year's trading has resulted in a loss of £93,484, as against a loss in the previous year of £65,397. "One cannot disguise the fact," said the chairman, "that this is a very serious loss, the more serious because our capital is exhausted, and we are in debt to the bank and to the holders of the other debentures to the tune of over £204,000." It was pointed out that had 1923 prices, or even 1924 prices remained the same in 1925, the company would have made a considerable profit. The output of coal increased during the year by 33 per cent., the colliery is in a better position for turning coal than it has ever been, and the directors expect that the output this year will be considerably over 500,000 tons, if they are able to continue working. The company badly needs a washing plant for the slack, which contains from 18 to 28 per cent. of dirt, and this plant will cost, with sidings, aerial ropeway, &c., about £40,000. It is erecting a 1500-kilowatt generator, and putting in additional main haulage, both of which are absolutely necessary. This will cost another £20,000. Extensions to sidings are also required at a cost of £8000. The company's total requirement of new capital is £330,000. "The question is, Can the money be found, and, if so, how?" asked the chairman. "We have made several applications to the Trade Facilities Board, which has turned us down because we have no record of success behind us, and because we cannot give it a first charge upon our undertaking nor find collateral security. We have also approached several financial houses, but hitherto without success. It would be no use going to the public with an issue of debentures. It seems to me that pits like our own, with a very large area of proved coal as yet only partly developed, ought to receive some assistance in the way of loan from the Government, even though the subvention is dropped at the end of April. It would not only be a calamity to our shareholders if this colliery should have to be closed, but would mean the loss of many millions of tons of workable coal to the nation. I hope to have an opportunity of placing this point of view before the responsible authorities in a short time."

Other Mining Topics.

The mining plant belonging to the Westminster Colliery Company at Moss and Gwersyllt pits, Wrexham, has been purchased by Thos. W. Ward, Ltd., Sheffield, for dismantling. The same firm, by the way, has purchased the phosphoric acid, phosphates and other chemical plant of Victors, Ltd., Sutton Oak, St. Helens. A £25,000 sewerage scheme for Ollerton and Boughton will be necessary in order to accommodate the new village built by the Butterley Colliery Company. Application for borrowing powers has been made. Interesting references to the hidden coalfields of the Humber region were made at Hull by Sir John Flett, Director-General of the British Geological Survey. The limit for working coal at the present time, he said, was about 3000ft., but with improved resources, methods of boring and machinery, there was no doubt that even greater depths would be reached, and would enable coal to be worked at a profit. Sir John made the announcement that in order to continue research work in Yorkshire a special branch of the Department has been set up with headquarters at Sheffield. The staff consisted entirely of Yorkshiremen, and the evidence they were obtaining was of the highest geological and commercial value, and might have an important bearing on the future coal resources of the country.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE threat of an engineering lock-out and the uncertainties of the coal situation since the issue of the report of the Coal Commission, have had a paralysing effect upon the industrial markets in the North of England. Only consumers in urgent need of supplies are prepared to buy at all, and then only sufficient to cover immediate needs. The general disposition is to mark time until the industrial and political outlook becomes clearer. The iron and steel markets, in particular, have assumed a very quiet appearance. Normally such a contraction in the volume of business might have been accompanied by a fall in prices, but the makers are, on the whole, successfully resisting bear pressure. The existence of the Cleveland makers' ring, no doubt, strengthens their position, but at the back of it is the solid determination not to incur further losses, and as present prices do not cover the cost of production, any price cut would inevitably incur financial sacrifices. Moreover, it is by no means certain that the more sluggish flow of orders is not merely a passing phase. The general industrial situation tends gradually to improve, and if a settlement is reached with the engineers and the miners, trade may take another spurt.

Cleveland Iron Market.

There is no new feature in the Cleveland pig iron market. With the supply barely sufficient to meet the current needs, makers are able successfully to resist customers' persistent efforts to break the prices that have been recognised as market rates for some time past. Buyers endeavour to justify their claim for price concessions by a reduction in the cost of output as the result of the cheapening of coke, but pig iron producers declare that even under present conditions they are manufacturing at a loss. Continental competition is stated to be hardly so keen as it has been, but a good deal of foreign and Midland iron, as well, is being taken up by firms in this country which used to depend chiefly on this district for their supplies. Exports continue on a light scale, and sales to customers abroad are few and small, but home needs absorb nearly all the iron available for distribution. Quotations remain unaltered, as follows:—No. 1 Cleveland foundry iron, 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. All these are home prices, and export quotations are 6d. per ton more.

Hematite Pig Iron.

The market for East Coast hematite pig iron seems weaker. Very few export orders are coming to hand, and as the home demand is not sufficient to absorb all the output, the market is inclined to sag a little. East Coast mixed numbers are now obtainable at 77s., and No. 1 at 77s. 6d. per ton.

Ironmaking Materials.

Consumers of foreign ore are well situated with regard to stocks, and new business continues very quiet. Although sellers nominally quote 21s. 6d. per ton c.i.f. Tees for best Rubio, that is more than can be realised. All the collieries are pursuing a very cautious policy as regards offerings of fuel, but there is a fair amount of Durham furnace coke for disposal, and prompt lots can be bought at 19s. per ton delivered at the works.

Manufactured Iron and Steel.

Much quieter conditions prevail in the manufactured iron and steel trade. One or two branches are fairly well employed, but in others orders are badly needed. There is a good deal of cutting in prices for export orders, but quotations for home trade are maintained.

The Coal Trade.

The Northern coal trade is in an unsettled state on account of the publication of the Coal Commission's report. As a result of that report, prices have taken a higher tendency, because of the desire of many consumers to lay in stocks in the event of a stoppage in the mines. At the moment, the talk of a stoppage appears to be quite unjustified, for there are strong hopes of employers and workmen getting together and endeavouring to solve their problems. The absence of inquiries from abroad, either for new business or on contract, which has been a feature of the market for the past three or four weeks, has now been relieved, and inquiries are numerous. Merchants who bought three months ago on the rise are having considerable difficulty in taking their commitments, which is a sign of an unsteady market. Best Northumberland steams maintain a steady position for the rest of March, a period which is holding keen attention on the part of buyers, and there is some competition for the limited supplies offered. Prices range from 16s. 6d. to 17s. for best quality steams. There continues a quiet request for other steam makes, and Tyne primes remain at 15s. to 16s. 6d., and seconds at 14s. 6d. to 14s. 9d. Steam smalls are merely nominal, and record no change from the issuing of the coal report. There is no special development in the inquiry for Durham coals, and the market is quiet. Sellers, however, are not numerous, while steadier prices are asked for seconds, and full late prices for best qualities. Gas coals now show all-round steadiness at 17s. 6d. to 18s. for bests and 19s. to 19s. 6d. for Wear specials. There is a slow sale for coking coals, but positions are steadier, with a consequent improvement in value to 14s. 6d. to 15s., according to quality. Secondary bunkering fuel is slightly better also, with 14s. 6d. to 15s. now quoted, and best and superiors keep to 15s. 6d. to 17s. The coke trade remains dull, and the tone is easier. Makers ask recent prices, but the position favours buyers, and counter offers are not lightly turned down. Gas coke is nominal at about 21s. to 23s. Patent oven cokes are 18s. to 20s., and beehive coke 26s. to 32s.

SCOTLAND.

(From our own Correspondent.)

Marking Time.

LITTLE change is noticeable in the steel, iron, coal and allied trades, in respect of the amount of business passing. There is little doubt that the possibility of industrial trouble is restricting operations in various markets, and the opinion is confidently held that, given an assurance of freedom from labour troubles over a reasonable period, orders for all classes of material would be plentiful. Meanwhile producers and consumers alike await eventualities.

Pig Iron.

The pig iron market continues in a state of partial activity only. Neither the home nor the export demands are large enough to strain outputs, which have been severely cut down, and the stocks in the market yards are still increasing. Quotations are nominally unchanged, but when good business is in prospect prices are purely a matter of arrangement.

Steel.

The steel works have not yet begun to feel any benefit from the shipbuilding orders recently placed with Clyde yards, and the lack of new business is becoming more keenly felt. A limited number of inquiries are to hand on home and export account, but exceptionally keen competition is met with, especially in respect of the latter. Ship plates and sections are quoted about £7 10s., and £7 per ton respectively, but some makers are prepared to give considerable concessions on these prices for prompt orders. The demand for boiler-plates is most moderate.

Steel Sheets.

Light steel sheets continue to experience a firm demand, especially on export account, and makers are very busy with orders for black and galvanised descriptions. Heavy gauges are not so satisfactory, however, and producers would welcome more business in them.

Fish-plates.

It is reported that local makers have secured a fair proportion of the orders placed for the supply of fish-plates on behalf of the London and North-Eastern Railway Company.

Coal.

The depression in the Scottish coal trade has not been relieved to any extent during the past week. Many collieries are still engaged in an endeavour to dispose of fuel contracted for by shippers earlier in the year, but which they cannot now take up owing to the failure of anticipated orders from foreign consumers. In many instances the colliery sidings are congested with this fuel, and cheap prices are being quoted in order to unload. Shippers therefore are suffering considerable loss in the process. Since the publication of the repors by the Coal Commission, some collieries have been endeavouring to secure firmer prices, but very little, if any, success has attended their efforts in that direction. As a matter of fact, even when cheap terms are offered considerable difficulty is experienced in disposing of even the most moderate quantities. In some cases the prices now quoted are lower than those current before the start of the boom in January last. Aggregate shipments amounted to 211,421 tons, against 206,103 tons in the preceding week and 220,103 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THERE has been no outstanding development since I wrote a week ago, although the publication of the report of the Coal Commission at the end of last week occasioned something in the nature of a stir in coal trade circles. The excitement lasted about forty-eight hours, since when everyone appears to have adopted a philosophical attitude, and is prepared to wait and see what happens. If anything there is more evidence that coalowners and exporters are disposed to suspend judgment on the report until able to give it greater study and consideration. At the onset, however, there was no mistaking that the view generally prevalent was, that it was disappointing, inasmuch as it was not calculated to solve immediate difficulties. It was agreed that the troubles of the industry were clearly set forth, but the remedy was more obscure. It was also questioned very much in some quarters whether the report would in any way be helpful to a solution of the problem for the reason that it covers such a wide field and raises so many points that are admittedly of such a highly controversial character. There are, of course, sections of the report which will please all parties; but, on the other hand, there are proposals which equally meet with a hostile reception. Many coalowners regard the propsoals put forward in the report as contradictory and impossible. This is particularly so in respect of the introduction of a five-day working week, which for South Wales would be fatal. It is further held that the effect of the report is to place coalowners in a worse position than they were before the subvention came into operation, for the reason that, as the result of the subvention, prices of coal have been reduced to a lower level, and the coalowners are therefore not in a position to make the workmen as good an offer as they were nine months or so ago. Scarcely anyone thinks that the subvention will be altogether withdrawn at the end of April, notwithstanding the report's condemnation of it, with which most people agree. It is, however, realised that the sudden cutting off of the subsidy would bring about a chaotic condition, which might spell disaster. The opinion is therefore held that it will be continued perhaps on a sliding scale and on different conditions.

Effect on the market.

So far as the market is concerned the report has created a certain amount of uneasiness. Previously the view had been held that there was scarcely likely to be a stoppage of work in the industry at the end of April, but coalowners and exporters do not now feel so sure that there may not be trouble, though they naturally hope that it will be avoided. The bugbear of uncertainty has now crept in to a greater extent, and it is felt that this unfortunate condition will be in evidence for some weeks if not right up to the end of next month, which is disturbing to business. Coalowners are already adopting a very cautious attitude and are not selling ahead. In a number of instances they are declining to carry forward from this month any arrears on sales to next month. There has been no rush of orders from abroad so far, but it cannot be denied that there are a few more inquiries on the market for single cargoes. It is not unlikely that the next week or so will witness an influx of additional demands, which may lead to a tightening up in coal prices and in outward freight rates to the discomfiture of those who have entered into commitments on a c.i.f. basis. Certainly, increased activity in shipments is looked for during the next five or six weeks, especially to foreign coaling depôts, which must be kept well supplied with coals and which must be stocked in case there may be a stoppage.

Coalfield Developments.

It is reported that plans are well in hand for new sinkings by Messrs. Guest, Keen and Nettlefolds, at Lower Cwmgorse, Swansea Valley, where there are several thousand acres of virgin coal measures of best anthracite. It is understood that it is proposed to sink to the Peacock Vein, a depth of 1800ft. All the plant and machinery is to be steam driven, and a daily raising of about 1200 tons is expected. The coal is now worked by the company's collieries at Gwauncaegurwen—viz., the Maerdy and East pits—about one and a half miles from the proposed new collieries. The company has in course of construction all the necessary surface equipment for the raising of coal at its new Steer pit at Gwauncaegurwen, where the middle and Lower viens will be worked. The present output at the Maerdy and East pits totals over 6000 tons weekly, but it is calculated that that amount will be doubled in a few years.

South Wales Executive and Coal Report.

The Executive Council of the South Wales Miners' Federation has decided to appoint a small committee to draw up a brief summary of the recommendations of the Coal Commissioners for submission to the next meeting of the Council before issuing the report to the lodges.

Trade Depression.

Consequent upon trade depression, the workmen at the Crown Colliery, Llanelly, have received fourteen days' notice to terminate their contracts.

Norwegian State Railways.

There is an inquiry on the market for 40,000 tons of large coal for delivery up to September for the Norwegian State Railways.

Current Business.

The tone of the market for steam coals is very steady, both for large and small coals. The tonnage position is much better than was the case last week. The quantity of tonnage which came to hand last week-end was sufficient to result in a number of vessels having to wait to get a loading berth. The result is that the weakness for spot shipment has very largely disappeared, and many collieries, owing to their considerable commitments, have no coal to spare for the remainder of this month, and they are not quoting firm prices for shipment during April, except in isolated instances. It is reported that one Belgian firm has purchased from this district about 25,000 tons of coking smalls for delivery over the next few months, but apart from that no new business of an extensive character has been announced. Anthracite coals are for the moment on the quiet side, and are irregular for early shipment. At the end of last week the strike of pitwood workers at Bordeaux and adjoining French ports came to an end, with the consequence that pitwood prices experienced a sharp set-back. Whereas values had been about 40s. to 42s. 6d., the price has fallen to 27s. 6d. to 30s. ex-ship.

CATALOGUES.

WALWORTH MUNZING, Ltd., 90–96, Union-street, Southwark, S.E. 1.—General catalogue No. 68, containing particulars of pipe fittings, tubes, valves, cocks, &c.

THE ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C. 2.—Publications No. 738 and 739, dealing with oil-immersed circuit breakers, Class O.K.B.

THE ERNEST SINCLAIR HOIST AND TROLLEY COMPANY, 14, Brompton-road, S.W. 1.—Leaflets describing several types of hoisting and transporting gear and accessories.

THOS. W. WARD, Ltd., Albion Works, Savile-street, Sheffield.—Lathe and capstan catalogue No. 147, illustrating and describing a large number of continental machines for sale.

THE MACO TEMPLATE AND ENGINEERING COMPANY, Ltd., Audrey House, Ely-place, E.C. 1.—Folder, containing description and uses of the "Maco" patented adjustable template.

CARBS (BIRMINGHAM), Ltd., Artillery-street Works, Birmingham.—Folder containing panels showing the various colours in which cellulose finishes are made for motor car painting and a booklet illustrating specimen shades of washable water paints.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has been successful in obtaining a thirteen months' contract from the London and North-Eastern Railway (Scottish area) for the supply of Mazda electric lamps.

EMPRESS COPPERSMITHS AND ENGINEERS, Ltd., of Empress-street, Cornbrook, Manchester, has received from the Yorkshire Electric Power Company, Ltd., the order for the corrugated copper expansion pieces required in connection with the circulating water piping at the new Ferrybridge Power Station.

JAMES POLLOCK SONS AND CO., Ltd., 3, Lloyd's-avenue, London, E.C. 3, have received an order from clients abroad for four motor tugs and two towing lighters. One tug will have a length of 60ft., a breadth of 14ft., and a draught of 4ft. The machinery will consist of a 120 brake horse-power two-cylinder Bolinder direct reversible heavy oil marine engine of the latest B.M. 20 type. The remaining three motor tugs will each have a length of 60ft., a breadth of 16ft., and a draught of 1ft. 6in. when loaded with 10 tons of cargo. The propellers, which will be driven by 60 brake horse-power engines, will work in a tunnel. The towing lighters will each have a length of 72ft. 6in., a breadth of 20ft., and will carry 100 tons on a 4ft. draught.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

BROOKHIRST SWITCHGEAR, Ltd., asks us to announce that at the end of the present month it will transfer its Birmingham office from County Chambers, Corporation-street, to Essex House, Temple-street.

THE Council of Sheffield University, at its meeting on the 12th inst., decided to confer the title of Honorary Professor of Mining on Mr. Douglas Hay (late Professor of Mining). The Council also appointed Mr. R. A. Mott, M.Sc., to the post of Research Assistant in Fuel.

HAVING outgrown its present establishment in Paradise-street, Birmingham, the British Thomson-Houston Company has acquired new premises in a central position in the city. Its new address is 10 and 11, Snow-hill, Birmingham. Telephone number, Central 8301 (six lines); and telegraphic address, "Asteriodal, Birmingham." It is requested that all future communications should be sent to the new address.

THE INSTITUTION OF CHEMICAL ENGINEERS.—Examinations for the associate-membership of the Institution will be held in June and July next. Particulars of the examinations and the memorandum on "The Training of a Chemical Engineer," may be obtained on application to the hon. registrar, Mr. C. S. Garland, the Institution of Chemical Engineers, Abbey House, Westminster, London, S.W. 1.

UNDERGROUND WATER.—Owners of property with their own water supply from wells, or any who contemplate sinking or extending any well, should study the "Report by the Advisory Committee on Water Measures for the Protection of Underground Water," recently issued by the Ministry of Health as a preliminary to drafting a legislative measure. As this report is very far-reaching and likely seriously to affect owners of wells supplying business premises, hotels, &c., and, in fact, all except those from which the water is solely for ordinary domestic purposes, the National Association of Water Users, Ltd., is watching the question with a view to taking what action may be considered necessary. The Secretary, Mr. Walter Scott, M.R.S.I., 46, Cannon-street, London, E.C. 4, will be glad to hear from those interested.

EDUCATION OF APPRENTICES IN THE ENGINEERING TRADES.—The London Association of Foremen Engineers, which during its seventy-four years of existence has attempted in various ways to encourage apprentices in the industry, has this year revised its programme and in conjunction with the London County Council has established a scheme for the award of prizes to approved students of mechanical engineering who submit finished pieces of work for competition in accordance with specified conditions. There will be awards of £5 and gold medal, £2 and silver medal, and £1 and bronze medal, and a silver shield to the institution presenting the winner of the first prize. Candidates must be following a satisfactory course of evening instructions in mechanical engineering at an institution aided or maintained by the L.C.C. Competitors must submit a finished piece of work done at the institution at which they are receiving instruction, or at their employers' workshops.

Current Prices for Metals and Fuels.

IRON ORE.

N W. COAST—	
Native	21/-
(1) Spanish	18/6
(1)N. African	18/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. COAST—		
Hematite Mixed Nos.	3 17 0	3 17 0
No. 1	3 17 6	3 17 6
Cleveland—		
No. 1	3 12 6	3 13 0
Silicious Iron	3 12 6	3 13 0
No. 3 G.M.B.	3 10 0	3 10 6
No. 4 Foundry	3 9 0	3 9 6
No. 4 Forge	3 8 6	3 9 0
Mottled	3 7 6	3 8 0
White	3 7 6	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 3 0 to 3 4 6	
,, Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 6 0 to 3 7 0	
Forge	3 2 0 to 3 3 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 10 0 (a), 4 12 6 (b), 4 17 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	—
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 0 0 to 12 0 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 11 0 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up.	7 10 0	—
Sections	7 0 0	—
Steel Sheets, under 3/16in. to ¼in.	9 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£17 to £18

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 7 6	—
Angles	7 0 0	—
Boiler Plates	11 10 0	—
Joists	7 0 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light ,,	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
MANCHESTER—		
Bars (Round)	8 0 0 to 8 5 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	7 12 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 0 0 to 6 2 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 0 0 to 16 5 0	
Angles	7 0 0 to 7 5 0	
Joists	7 0 0 to 7 5 0	
Toes	8 2 6 to 8 5 0	
Bridge and Tank Plates	7 15 0 to 8 0 0	
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	297 12 6
,, (three months)	288 15 0
Copper (cash)	59 2 6
,, (three months)	60 0 0
Spanish Lead (cash)	31 18 9
,, (three months)	32 8 9
Spelter (cash)	33 15 0
,, (three months)	34 2 6
MANCHESTER—	
Copper, Best Selected Ingots	64 10 0
,, Electrolytic	67 5 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
,, Condenser	0 1 2½
Lead, English	34 0 0
,, Foreign	33 10 0
Spelter	35 5 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	2/1 per lb.
Ferro Tungsten	1/9½ per lb.

	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£39 0 0	14/-
,, ,, 1 p.c. ,,	£44 10 0	14/6
,, ,, 0·70 p.c. carbon	£55 10 0	17/6
,, ,, carbon free	1/5½ per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/6 per lb.	
,, Molybdenum	6/- per lb	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£170	
Cobalt	10/- to 11/- per lb.	
Aluminium (per ton)	£120	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/-
,, ,, Ell	15/3
,, ,, Splint	16/- to 18/-
,, ,, Trebles	15/6
,, ,, Doubles	13/3
,, ,, Singles	12/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	15/6
,, ,, Jewel	16/9
,, ,, Trebles	15/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/10½ to 15/3
Screened Navigation	21/-
Trebles	15/- to 17/-
Doubles	12/9
Singles	12/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/3
Secondary Steam	13/6
Trebles	14/6
Doubles	13/-
Singles	12/3

ENGLAND.

(8) N.W. COAST—	
Steams	24/6
Household	40/- to 48/-
Coke	26/-
NORTHUMBERLAND—	
Best Steams	15/6 to 15/9
Second Steams	14/6
Steam Smalls	8/- to 8/6
Unscreened	13/- to 13/6
Household	20/- to 22/-
DURHAM—	
Best Gas	17/6 to 18/-
Second	14/6 to 15/-
Household	20/- to 22/-
Foundry Coke	18/- to 20/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	31/- to 34/-	
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	26/- to 28/-	—
,, ,, House	24/- to 25/-	—
,, ,, Large Nuts	17/- to 20/-	—
,, ,, Small	12/6 to 14/-	—
Yorkshire Hards	17/- to 19/6	—
Derbyshire ,,	16/- to 19/-	—
Rough Slacks	10/- to 12/6	—
Nutty ,,	7/6 to 9/-	—
Smalls	3/6 to 6/-	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	16/- to 17/-

CARDIFF— (9) SOUTH WALES,	
Steam Coals:	
Best Smokeless Large	23/6 to 24/-
Second ,, ,,	21/6 to 22/6
Best Dry Large	21/- to 23/-
Ordinary Dry Large	20/- to 20/6
Best Black Vein Large	21/- to 21/6
Western Valley Large	20/- to 20/6
Best Eastern Valley Large	20/- to 20/6
Ordinary ,, ,,	19/- to 20/-
Best Steam Smalls	12/6 to 13/-
Ordinary ,,	11/- to 12/-
Washed Nuts	19/- to 29/-
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	15/6 to 16/-
No. 2 ,, Large	19/6 to 20/6
,, ,, Through	16/- to 17/-
,, ,, Smalls	10/6 to 11/-
Foundry Coke (export)	37/6 to 40/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	20/- to 22/6
Pitwood (ex ship)	23/- to 24/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	39/6 to 41/-
Seconds	30/- to 32/6
Red Vein	27/- to 29/-
Machine-made Cobbles	50/- to 52/6
Nuts	50/- to 52/6
Beans	41/- to 43/-
Peas	21/- to 24/-
Breaker Duff	7/- to 7/6
Rubbly Culm	9/- to 10/-
Steam Coals:	
Large	22/- to 23/-
Seconds	20/- to 22/-
Smalls	9/- to 10/-
Cargo Through	16/- to 17/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market, 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Iron and Steel Trades.

THE further depreciation of the franc has had the effect of stimulating a demand from consumers who desire to cover their future requirements and of providing producers with additional facilities for selling in foreign markets. Mill and forge owners have therefore plenty of work in hand, but they are reluctant to accept orders for future delivery. The outlook is too uncertain to allow of manufacturers undertaking forward commitments. The currency depreciation was at one time accepted with complacency in the belief that it was a powerful aid to industrial activity, but the effects in other directions are so serious that the downfall of the franc is regarded as a disaster, even by those who are profiting from it at the moment, and there is a growing conviction that unless something is done immediately to stabilise the franc the whole industrial fabric will fall to the ground. It is now generally feared that the present fictitious prosperity will be followed by a collapse. What makes matters worse is the unfavourable position in which France is placed with regard to some other countries, where the work of economic reorganisation has been carried on for some time past and is now well advanced, while French manufacturers suddenly find themselves confronted with the prospect of supporting what they feel to be crushing burdens. To save the franc French manufacturers will have to make considerable sacrifices at a time when the German Government is voting large sums of money for the alleviation and encouragement of German industries. The fear of an industrial and commercial crisis is largely responsible for the timidity with which the French are grappling the financial problem.

The Rail Union.

At meetings held in Paris during the past week arrangements for the constitution of an international union of railmakers were so far advanced that the new body is likely to be definitely formed at an early date. The countries represented were Great Britain, France, Belgium, Germany and Luxemburg, and the claims of the smaller producing countries to be admitted into the Union will be considered when all the questions now under discussion are settled. The negotiations have been very protracted on account of the difficulty of fixing the percentage of each country in the European production of rails, but that has now been done by an adjustment which is regarded as quite equitable, and it is believed that all the other questions, such a selling prices, will be dealt with in the same spirit. It is obvious that, at a time when the capacity of production so largely exceeds the demand, the rail industry can only be saved from a collapse by a limitation of output and by the fixing of prices which will allow of a reasonable margin of profit. In other branches, also, negotiations are in progress, principally in Belgium, where makers of rods are hoping to come to an arrangement with German firms for the maintenance of prices, and although nothing definite has yet been done with the grouping of foundry iron producers, the prospect of some arrangement being come to has already had the effect of hardening values.

Shipping.

In a report presented at the annual meeting of the Comité Central des Armateurs, it was stated that the tonnage of merchant shipping was 3,350,000 tons, as against 3,400,000 tons a year ago. This regression was due to the rapid disappearance of sailing ships, for during the year 80,000 tons of such vessels were broken up or sold abroad, though that was partly compensated for by the addition of about 40,000 tons of steamships. At the beginning of the year 233,221 tons of shipping were laid up, representing 6 per cent. of the merchant fleet, which was nearly 42,000 tons less than a year ago. The quantity of goods unladen from French vessels during the year was 30 million tons, or five million tons less than in the previous year, which corresponds with the contraction of imports of British coal. The goods loaded on to French vessels at French ports amounted to more than ten million tons. If the shipping industry has been able to maintain a relatively satisfactory position it is due largely to the traffic with the Colonies. That traffic is practically a monopoly of the French shipowners, especially with North Africa, and while the imports from the French Colonies were carried on French vessels to the extent of 87 per cent., nearly the whole of the exports to the Colonies were taken by French ships. The French participation in the entire seaborne traffic was 40 per cent. of imports and 60 per cent. of exports. The Shipowners' Association again finds it necessary to call the attention of Parliament to the danger of instituting reforms in the merchant marine that are not absolutely necessary. Seamen's wages have been advanced 15 per cent. to bring them up to the level of the higher living costs and negotiations are now being carried out with a view of inducing the seamen to work additional hours. The eight-hours' day in the merchant marine has been found quite inoperable, and that is fully recognised by the Government, which has been endeavouring to secure the acceptance by the seamen of more equitable conditions of working, but, as a general rule, the men cling so tenaciously to the rights accorded them by law that there is constant friction with the shipowners.

Seaborne Traffic.

Statistics just published of the traffic at the different French ports during 1925 show that the total tonnage of goods unloaded was 30,633,333 tons, as compared with 35,048,141 tons in the previous year. This was due almost entirely to the falling off in the imports of coal, the declension at Rouen alone being more than 1,500,000 tons, as compared with 1924. The quantity of goods loaded at the ports was 10,839,089 tons, an increase of 685,061 tons. On account of the contraction of coal imports Rouen lost the leading position it occupied in 1924, and it was again taken by Marseilles with a total of 7,421,530 tons of goods loaded and unloaded. Rouen was second with 6,943,760 tons, and then followed Havre, Bordeaux, Dunkirk and Nantes in that order.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

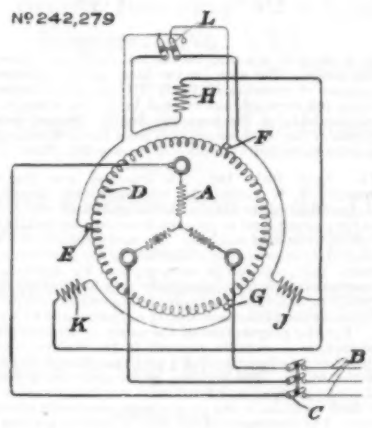
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

242,279. October 27th, 1925.—IMPROVEMENTS IN AND RELATING TO SYNCHRONOUS INDUCTION MOTORS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

This invention relates to alternating-current motors which are capable of synchronous operation over a very considerable range of loads and which begin to operate asynchronously when the load is increased beyond that range. The motor comprises a primary winding A, which is arranged to be supplied with current from the line B through the switch C, the winding A being inductively related to a regulating or adjusting winding D, mounted on the rotor core, together with the primary winding. The adjusting winding D is provided with a commutator, with brushes E, F and G, through which this winding is interconnected with the polyphase secondary windings H, J and K. A switch L serves for reversing the phase rotation of the secondary winding with respect to that of the adjusting winding D. Assuming the line switch C to be closed and the primary winding A to be energised, the motor will accelerate and will continue to run as an induction motor. Under these conditions the secondary

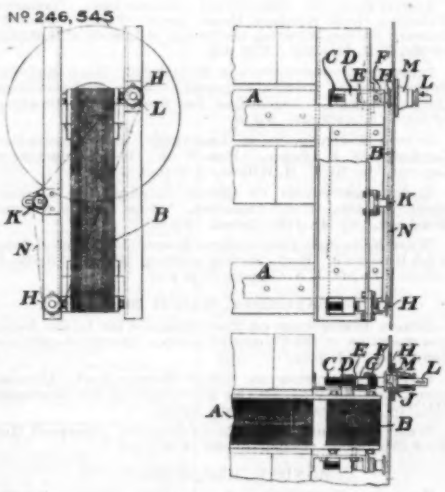


voltage of the motor is made up of two components, one of which is produced by reason of the inductive relation existing between the primary and secondary windings and the other of which is applied by the adjusting winding. For any given motor load the brushes E, F, and G may therefore be adjusted to enable the motor to operate at unity power factor, but any considerable departure from this load will result in a change of power factor. During induction motor operation, the secondary component voltages have the same phase rotation and the motor is incapable of pulling into synchronism. It has been discovered, however, that by reversing the phase rotation between the adjusting and secondary windings while the motor is operating asynchronously, by operating the reversing switch L, the motor may be made to pull into synchronism and that it will thereafter operate as a synchronous motor with leading power factor which becomes less leading as the load is increased. If the motor is loaded to such an extent that it falls out of synchronism, it will operate as an asynchronous motor at a higher power factor than the ordinary induction motor.—*February 4th*, 1926.

TRANSFORMERS AND CONVERTERS.

246,545. October 21st, 1924.—IMPROVEMENTS IN AND RELATING TO HIGH-VOLTAGE ELECTRIC TRANSFORMERS, Sebastian Ziani de Ferranti, and Ferranti, Ltd., both of Hollinwood, County of Lancaster.

In very high-voltage electric transformers, as made principally



for electrical testing and experimenting, a special difficulty is found to arise owing to the self-capacity of the transformer, which results in a considerably leading power factor. The power factor is largely varied by the frequency at which it is necessary to work for the particular test, and is also affected by the capacity of the system upon which tests are being made. This necessitates the provision of adequate plant capacity to supply the idle current. The object of this present invention is to meet this difficulty so as to reduce the amount of idle current required in such apparatus. The invention consists briefly in reducing as desired the idle current necessitated in a very high-voltage transformer by providing the transformer with a magnetic circuit of variable reluctance. The transformer is constructed with a yoke A, the yoke end B being movable so as to vary the air gap according to the circumstances under which the transformer is being used at any particular time. The movement of the yoke end B is effected by screws C, which engage with threaded blocks D attached rigidly to the yoke end. The screws are provided with collars E and nuts F, which locate the screws in bearings G and each carries a sprocket wheel H. An endless chain N couples the two sprockets, a jockey sprocket K serving as convenient tensioning means, and one of the sprockets is coupled by an Oldham coupling J to an operating spindle L, which passes through a stuffing-box M.—*January 21st*, 1926.

TELEGRAPHS AND TELEPHONES.

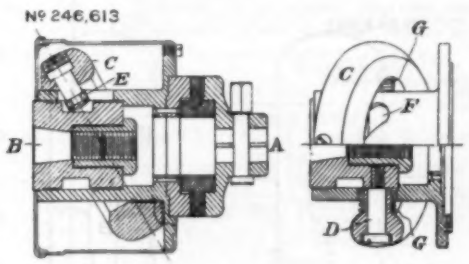
246,359. May 4th, 1925.—IMPROVEMENTS IN INDUCTANCE COILS FOR USE IN HIGH-FREQUENCY TELEGRAPHY AND TELEPHONY, *Arthur Carpmael, of 24, Southampton-buildings, London, W.C. 2.*

It has been proposed to make high-frequency inductance coils for use in telegraphy and telephony with cores formed of thin wire of a diameter less than $^1/_{10}$ mm. It has also been proposed to employ a nickel iron alloy for loading purposes in connection with cables. According to this invention, the metal of the wire of which the core is formed is composed of a nickel-iron alloy. The nickel-iron alloy employed preferably consists of about 80 per cent. nickel and 20 per cent. iron.—*January 28th*, 1926.

TRANSMISSION OF POWER.

246,613. November 19th, 1924.—SHAFT COUPLINGS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and L. Griffiths, 18, Grafton-street, Coventry.

This coupling is intended for driving the magnetos of internal combustion engines, and is so arranged that it advances or retards the armature with respect to the driving shaft, according

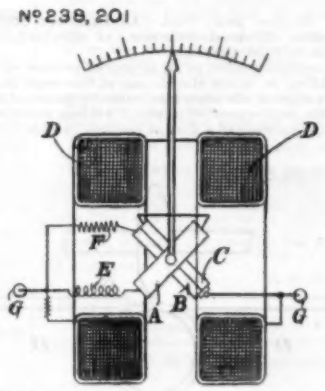


to the speed of the engine. A is the driving shaft and B the magneto shaft. The connection between the two is effected by means of the heavy ring C, which is mounted on the pivots D and a roller E. This roller works in the cam path F, and as the ring assumes a normal position, in opposition to the springs G G, the relative position of the two shafts is altered by the roller moving in the cam path.—*February 4th*, 1926.

MEASURING AND TESTING INSTRUMENTS.

238,201. July 10th, 1925.—IMPROVEMENTS RELATING TO ELECTRICAL MEASURING INSTRUMENTS, Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

The instrument described gives relatively large deflections for small changes in frequency of the current. The instrument comprises movable coils A, B and C, arranged to intercept the magnetic field produced when current traverses a stationary coil D. The coils B and C are fixed at right angles to the coil A and the coil C is wound in the opposite direction to the coil B. A pointer is attached to the coils A, B and C as shown. A reactance E is connected in series with the movable coils A and C and a resistance F is connected in series with the movable coil



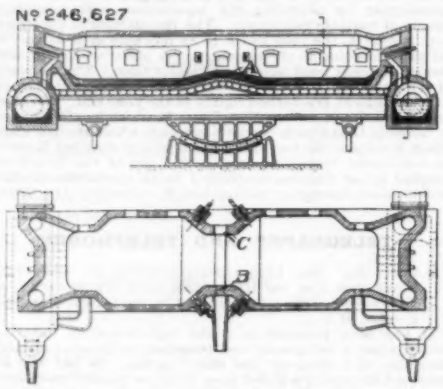
B. The stationary coil D is connected across the line terminals G. As the frequency of the applied voltage changes, the current through the coils A and C changes by reason of the variation of the impedance of the reactance E. Accordingly, the resultant magnetic field produced by current traversing the movable coils A, B and C changes, and produces a change in the resultant torque between the movable coils and the field coil D, thereby deflecting the pointer. Since the magnetic field produced by the current traversing the coil C opposes the magnetic field produced by the current traversing the coil B, a relatively large change in the resultant magnetic field, and therefore a relatively large deflection of the pointer, is obtained for a given change of frequency. The precise theory of the instrument is fully described.—*February 4th*, 1926.

FURNACES.

246,627. December 5th, 1924.—STEEL FURNACES, B. Talbot, County Bank Chambers, Marton-road, Middlesbrough.

This furnace is intended to be operated continuously, and for that purpose it is desirable that when it is tapped a considerable

quantity of refined molten metal should be left in the bath. The bottom of the furnace is consequently provided with a bulge A, and at this part has one or more tapping holes, such as that indicated at B. In the vicinity of the tapping hole, it will be

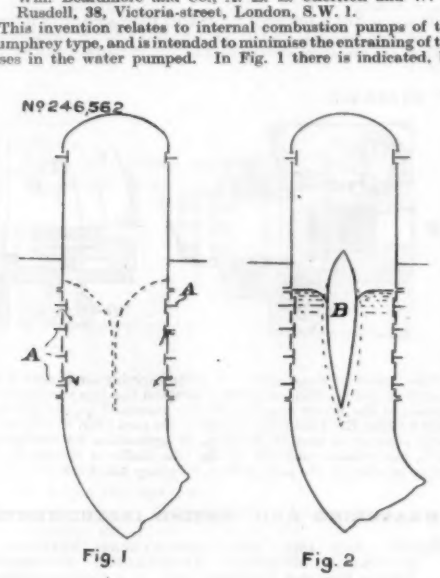


seen, the walls of the furnace are recessed, and a corresponding recess is made on the opposite side, so that the furnaceman can conveniently control the tap hole through the opening C.—*February 4th*, 1926.

PUMPING AND BLOWING MACHINERY.

246,562. October 27th, 1924.—Internal Combustion Pumps, Wm. Beardmore and Co., A. E. L. Chorlton and W. J. Rusdell, 38, Victoria-street, London, S.W. 1.

This invention relates to internal combustion pumps of the Humphrey type, and is intendad to minimise the entraining of the gases in the water pumped. In Fig. 1 there is indicated, by

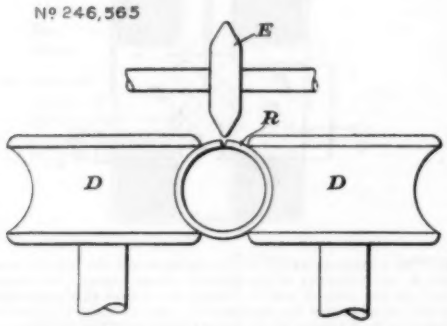


dotted lines, the assumed surface of the water as it flows in through the valves A A. It will be seen that the hollow centre tends towards the entraining of gas. As a consequence, the inventors arrange a core B—see Fig. 2—which fills up the depression in the water surface. It is suggested that the core may be allowed to rise and fall with the water level, and be used to operate the gas valves.—*January 27th*, 1926.

WELDING.

246,565. October 28th, 1924.—An Improved Arc Welding Process, Edmund Schröder, of Maybach-Ufer 48/51, Berlin, S.O. 36, Germany.

This invention relates to an improved process of electric arc seam welding, in which the closing of the seam is effected by fusing the edges of the seam into union by means of an electrode without the employment of a special welding material. E is the electrode, consisting of a disc of silicium carbide or some other

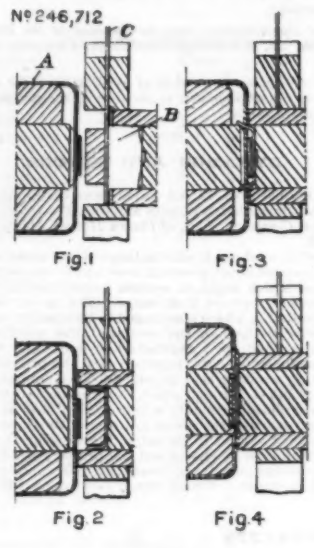


non-oxidisable, bad heat-conducting material. The electrode is connected, by means of its shaft bearings or by means of slip rings, with one pole of the source of supply of current, while the pressure rollers D D, which press the seam edges of the tube together and feed the tube forward, are connected to the other pole. When starting, the electrode E is rotated slowly, the speed of rotation being then increased up to working speed.—*January 28th*, 1926.

MISCELLANEOUS.

246,712. May 27th, 1925.—Forming Wire Hinges in Metal Boxes, W. G. Huxtable, Velattor, Glanmor, Swansea, and R. E. Gold, Lansdown, Newton, Mumbles, Swansea.

This machine is intended for putting in the hinge pins in sheet metal boxes, such as those used for the packing of tobacco or similar materials, and performs the operation in one compound movement. In the specification there are several illustrations of the mechanism and explanations of their functions, but the essentials of the invention may be gathered from the series of cuts reproduced. The body of the box is shown in



plan at A, while B is a tang on the lid which will subsequently form the hinge. The wire for the hinge pin is indicated at C. The sequence of operations is fairly obvious in the diagrams, the wire being fed forward, cut off and bent into a staple, forced through the body of the box, and finally clinched over. The mechanism of the machine appears from the illustrations in the specification to be quite simple.—*February 4th*, 1926.

247,071. June 26th, 1925.—A Process for Preventing Rusting, T. W. Coslett, 70, Vittoria-street, Birmingham.

This specification covers a development of the inventor's process for coating steel to prevent it rusting, by treating it with dilute phosphoric acid and zinc. He now proposes the addition of boric acid, to improve the uniformity of the protective deposit. A suitable bath solution is one prepared by dissolving pasty or concentrated acid zinc phosphate and boric acid (powdered or crystals) in water, in the approximate relative proportions of about 2 oz. of the phosphate and 1½ oz. boric acid to 1 gallon of water. For the preparation of the pasty or concentrated acid zinc phosphate a suitable method is to dissolve 6 oz. finely granulated or powdered zinc in ½ pint phosphoric acid B.P. and ½ pint hot water. The solution is set aside for a few hours, stirred, and a pasty or powdered mass suitable for use in making up the bath solution in the proportions previously mentioned is obtained. The treatment of the iron or steel or articles with an iron or steel surface is preferably carried out with a hot solution.—*February 11th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Lubricating and Allied Oils," by Mr. E. A. Evans. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate Westminster, London, S.W. 1. Paper, "The High-efficiency Oil Engine," by Mr. A. E. L. Chorlton. 6 p.m.

Institution of Municipal and County Engineers.—Victoria Hotel, Deansgate, Manchester. North-Western District meeting. Address on "New Legislation Affecting Local Authorities, including the Public Health Act, 1925, and the Roads Improvement Act, 1925," by Sir Lewis Beard. 2.30 p.m.

Institution of Structural Engineers: Yorkshire Branch.—Great Northern Hotel, Leeds. Paper, "Some Preliminary Factors Affecting the Design of Industrial Buildings," by Mr. C. A. Harding. 6.30 p.m.

Institution of Structural Engineers: Irish Branch.—Physics Lecture Theatre, University College, Earlsfort-terrace, Dublin. Paper, "Regulations for Steel-framed Buildings," by Mr. E. S. Andrews. 8 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Pipe Work: Its Manufacture and Lay-out," by Mr. G. H. Willett. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "Chips from a Sculptor's Notebook," by Mr. John Tweed. 9 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Radio Section meeting. Paper, "Radio Distortion," by Mr. J. A. Cooper. 7.30 p.m.

SATURDAY, MARCH 20TH.

Junior Institution of Engineers.—Visit to the Barking power station of the County of London Electric Supply Company, Ltd. 2.15 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Rare Gases of the Atmosphere, III.," by Sir Ernest Rutherford. 3 p.m.

West Bromwich Engineering Society.—Sandwell Hotel, West Bromwich. Annual dinner. 6.30 p.m.

MONDAY, MARCH 22ND.

Bradford Engineering Society.—The Technical College, Great Horton-road, Bradford. Lecture, "The Application of the Steam Turbine for Industrial Purposes," by Mr. W. S. Burge. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Thermometry, Lecture II.," by Mr. W. F. Higgins. 8 p.m.

TUESDAY, MARCH 23RD.

Institution of Civil Engineers.—Great George-street, London, S.W. 1.—Paper, "The Construction of the Mountain Section of the Many Peaks to Northern Burnett Railway, Queensland," by Mr. A. E. Tuffley. 6 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. "Super-pressure Steam Generation," by Mr. D. Brownlie. 6.30 p.m.

Institution of Automobile Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "The Main Free Vibrations of an Autocar," by Professor J. J. Guest. 7 p.m.

Institution of Electrical Engineers: North Midland Centre.—Yorkshire Cinema Exchange, Queen's Arcade, Leeds. Paper, "Some Notes on the Installation of a Modern Power Unit," by Mr. J. W. J. Townley. 7 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Annual general meeting. Address by the President, Sir T. H. Holland. Discussion on Dr. Wade's paper, "The Search for Oil in Australia." 5.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Growth of Crystals," by Professor C. H. Desch. 5.15 p.m.

WEDNESDAY, MARCH 24TH.

Chemical Engineering Group.—Chemical Society's Hall, Burlington House, Piccadilly, London, W. 1. Symposium of papers on "Bearings and Lubricants." 3 p.m.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, Deansgate, Manchester. Paper, "The Metallurgist in Inspection and Design," by Mr. W. Toplis. 7.15 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Students' meeting. Paper, "The Erection of the Kwe Kwe Bridge," by Messrs. W. R. G. Taylor and B. H. Johnson. 6 p.m.

Institution of Production Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "Works System," by Mr. J. T. Kenworthy. 7.30 p.m.

Liverpool Engineering Society.—9, The Temple, Dale-street, Liverpool. Paper, "Application of Low-pressure Steam to Ship Heating," by Mr. A. J. Assheton. 8 p.m.

Radio Society of Great Britain.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Lecture, "Fading," by Professor E. W. Marchant. 6 p.m.

WEDNESDAY TO FRIDAY, MARCH 24TH TO 26TH.

Institution of Naval Architects.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Spring meetings. For programme see page 296. 11 a.m. each day.

THURSDAY, MARCH 25TH.

Institution of Locomotive Engineers.—Engineers' Club, Coventry-street, London, W. 1. Annual general meeting. Paper, "Mechanical Couplers for Railway Rolling Stock," by Mr. A. M. Bell. 7 p.m.

Institution of Welding Engineers.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Electric Welded Construction," by Mr. J. Caldwell. 8 p.m.

FRIDAY, MARCH 26TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Foundry Practice, with Special Relation to Perlit Iron," introduced by Mr. Summers Hunter. 7 p.m.

Institution of Municipal and County Engineers.—9a, Victoria-street, London, S.W. 1. Metropolitan District meeting. Paper, "The Life of Wood Paving as Affected by Expansion," by Mr. J. Garvie. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Metal Aeroplane Construction," by Mr. A. Basil Miller. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Manchester. Paper, "Hydro-electric Engineering," by Mr. P W. Seemer. 7.15 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. Discourse, "The Radiation from Atomic Nuclei," by Sir Ernest Rutherford. 9 p.m.

SATURDAY, MARCH 27TH.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. Juniors' social and dance. 7 p.m.

Institution of Municipal and County Engineers.—Shire Hall, Nottingham. East Midland District annual meeting. 2 p.m.

Junior Institution of Engineers.—Visit to the Canning Town Glassworks, Ltd. 2.30 p.m.

Royal Institution of Great Britain.—21, Albemarle street, London, W. 1. "The Rare Gases of the Atmosphere, IV.," by Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 29TH.

Railway Club.—65, Belgrave-road, London, S.W. 1. Paper, "Electricity in Railway Operations," by Mr. W. J. Mitchelhill 7.30 p.m.

TUESDAY, MARCH 30TH.

Engineers' Club.—Albert-square, Manchester. Annual general meeting. 1.45 p.m.

Association of Special Libraries and Information Bureaux.—A business meeting, at which it is proposed formally to inaugurate the Association of Special Libraries and Information Bureaux, will be held at the Institution of Mechanical Engineers, Storey's-gate, S.W. 1, at 2.30 p.m., on Monday, March 29th, 1926. The Association is being formed to facilitate the co-ordination and systematic use of sources of information in science, industry, commerce, and public affairs generally. When fully developed, it will operate as a clearing house for those wishing to get into touch with specialised knowledge. The Association's first activity is to be the compilation of a Directory of special libraries and informaton bureaux in the British Isles. No complete list exists at present, and the Directory should therefore prove a valuable book of reference. The work will be authoritative, and will indicate the sources where both scientific and non-scientific information may be obtained. The entries in the Directory are to be carefully annotated throughout. The whole movement is deeply indebted to the Carnegie United Kingdom Trustees, who, in addition to setting aside the sum of £1500 to assist the Association in the first two years of its work, have now generously undertaken to defray the cost of compiling the Directory. It is anticipated that something like a year will be occupied in collecting the necessary data. Those in touch with special sources of information, and willing to collaborate with the Association in building up the Directory are asked to communicate with the organising secretary (38, Bloomsbury-square, W.C. 1), from whom further information may be obtained.